

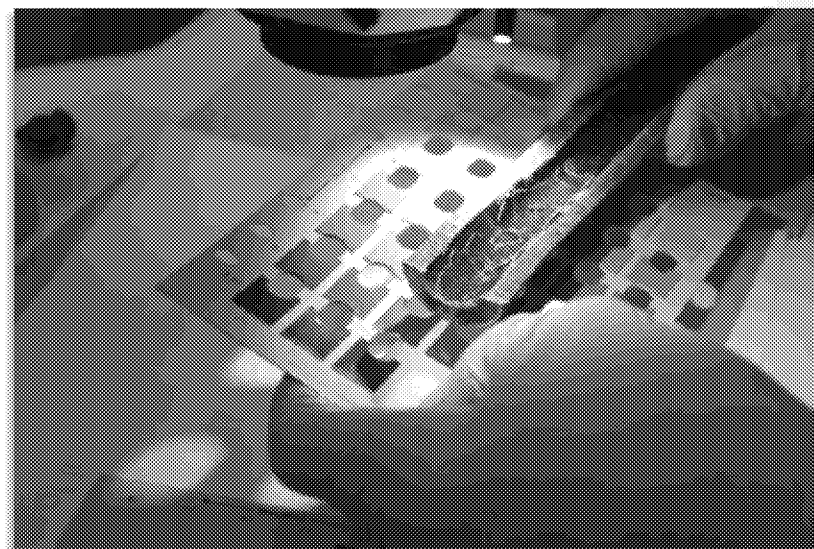
## SSWR 7.1.3: Lead and Copper Source Characterization and Assessment Strategies

**Problem:** The release of lead and copper from drinking water materials is largely related to the nature of materials including corrosion by-products, deposits and biofilm on material surfaces. The understanding of the make-up of these surfaces and how they relate to water quality and metal release are not well understood.

**Action:** Characterize the speciation of lead and copper on the surfaces of distribution system and premise plumbing devices, pipes, storage materials, and other solids to ascertain lead release mechanisms and corrosion control effectiveness. Will also consider the effects of biofilms on the corrosion of premise plumbing and how the resulting corrosion impacts biofilms.

**Results:** Pipe scale analyses for solving lead problems in communities (technical support). Outputs describing approaches to lead pipe scale analyses and best practices.

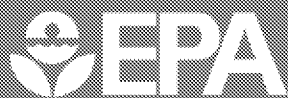
**Impact:** Improved understanding of the nature of pipe scales will help water systems improve corrosion control approaches and avoid unintended consequences of source water and treatment change related to lead and copper release.



**Product POC:** Mike DeSantis (CESER)

**Internal Partners:** OGWDW, EPA Regions

**External Collaborators:** ASDWA, cities, consultants, states



## SSWR 7.1.4: Lead and Copper Sampling and Monitoring Tools

**Problem:** There is a need to identify the appropriate method(s) to sample for lead and copper in water to achieve the desired objective. Furthermore, alternative Pb monitoring tools that can provide rapid and accurate measurements are needed.

**Action:** Develop novel tap sampling methods to meet various sampling goals and compare them against more common methods. Sampling methods to assess treatment effectiveness, and broader distribution system monitoring strategies to identify unintended consequences of corrosion control will also be examined.

### Results:

- ◆ The impact of sampling approach and daily water usage on lead levels measured at the tap.
- ◆ Field analyzers for lead quantification in drinking water samples.
- ◆ Development of a Lead Assessment and Exposure Device (Patent).

**Impact:** The information will inform or be directly used by states, consultants, and water systems to link desired lead and copper questions with the proper water sampling approach.

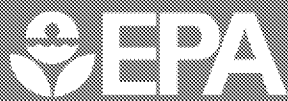


### Product POC:

Simoni Triantafyllidou (CESER)

**Internal Partners:** OGWDW, EPA Regions

**External Collaborators:** ASDWA, cities, consultants, states



## SSWR 7.1.5: Sampling for Lead Service Line Identification and Exposure Assessment

**Problem:** There is a need to identify the make-up of service material in cases where it is unknown. This knowledge will help water systems build lead service line inventories, prioritize lead service line removals and reduce lead exposure from drinking water.

**Action:** This product evaluates various methods to determine the presence of leaded materials within premise plumbing, particularly lead service lines, but considers all lead sources. This can be done in numerous ways from innovative tap sampling methods, novel sensors and visual inspection to remote sensing.

### Results:

- ◆ Lead Service Line Identification: A Review of Strategies and Approaches
- ◆ A Water Sampling Device for Assessing the Presence of LSLs: Demonstration
- ◆ Field Comparison of Water Sampling Approaches for Lead Assessment

**Impact:** This Product aims to advance knowledge on existing tools for lead service line identification and lead exposure assessment, but also aims to develop new such tools.



### Product POC:

Simoni Triantafyllidou (CESER)

**Internal Partners:** OGWDW, EPA Regions

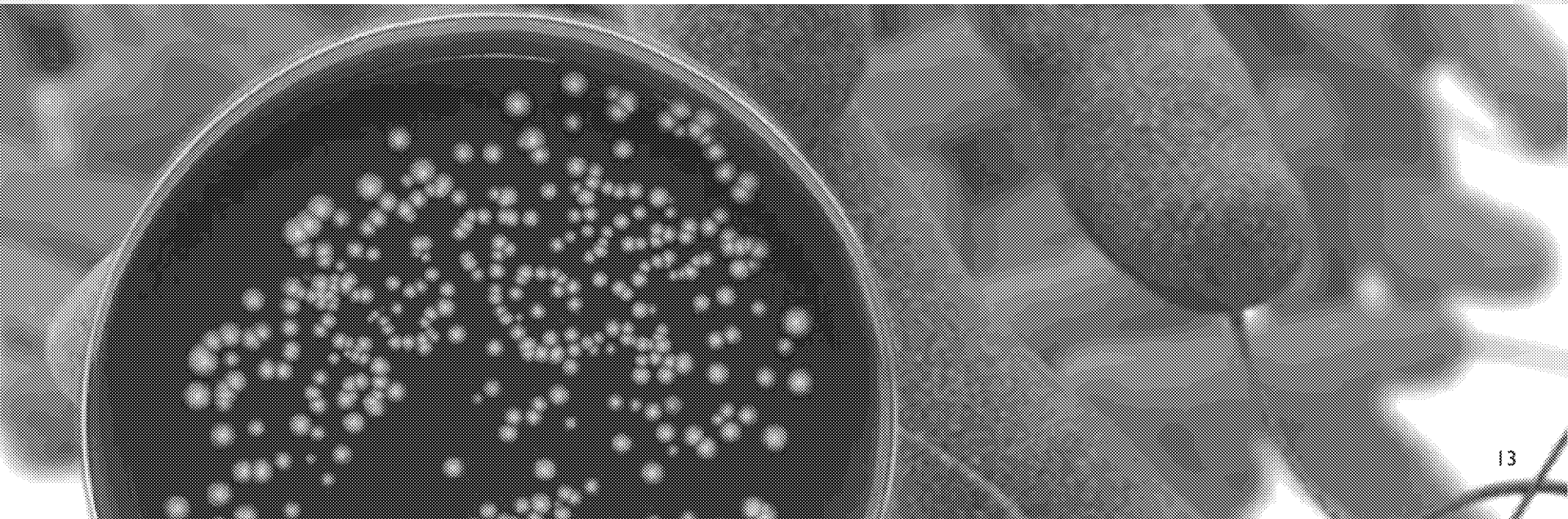
**External Collaborators:** ASDWA, cities, consultants, states



## Research Output 7.2

# **Best Practices, Tools, and Information for Assessing and Controlling Pathogens and Biostability in Drinking Water Systems, Managing Disinfectant Residuals, and Minimizing Disinfection Byproducts**

Lead: Eric Villegas





## SSWR 7.2.1: Understanding the Occurrence, Prevalence, and Control of *Legionella* Throughout the Drinking Water System

**Problem:** *Legionella* is the leading cause of infectious disease outbreaks from drinking water and the incidence continues to rise.

### Action:

- ◆ Evaluate the interplay between water quality parameters, microbial communities, engineering/plumbing designs, and *Legionella* in distribution and premise plumbing systems
- ◆ Use next-gen technology to understand *Legionella* in DWS
- ◆ Identify treatment technologies, pipe materials and, engineering designs that minimize risks associated with *Legionella*
- ◆ Develop tools to improve water management practices/treatment options and mitigation strategies to control *Legionella*

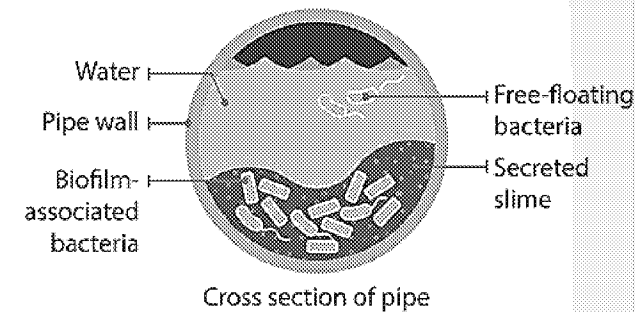
### Results:

- ◆ New and refined tools developed to monitor *Legionella* and other opportunistic premise plumbing pathogens (OPPPs) in distribution systems
- ◆ Key research collected for improved management plans to control *Legionella*
- ◆ Pipe materials and disinfectant residuals play an important role on *Legionella* and biofilm growth in distribution system and storage tanks
- ◆ Nano-based particles and UV-based disinfectants are effective on *Legionella*

### Impact:

Improved better management practices (building and utilities) aimed at reducing risks associated with *Legionella* and OPPPs.

*Legionella* can live and grow in biofilm



### Product POC:

Laura Boczek (CESER) and  
Jingrang Lu (CEMM)

**Internal Partners:** OGWDW,  
Regions

**External Collaborators:**  
Water utilities, AWWA

## SSWR 7.2.2: Disinfection Byproducts in Drinking Water Systems

**Problem:** More effective management of disinfectant residual and disinfection byproducts (DBPs) in distribution and premise plumbing systems while effectively reducing OPPPs are needed.

### Action:

- ◆ Use of bench scale and computer-simulated approaches to determine effective disinfectant concentrations to treat OPPPs and minimize DBPs.
- ◆ Understand the relationships between health risks associated with DBPs, disinfectant residuals, pathogen occurrences and corrosion control of public distribution systems and in-home premise plumbing.

### Results:

- ◆ Disinfectant demand in building plumbing systems evaluated.
- ◆ Penetration efficacies of disinfectants on biofilms evaluated.
- ◆ Optimal conditions to reduce DBPs and pipe corrosion in DS evaluated.
- ◆ Sensor technology developed to monitor inorganic contaminants (e.g., bromide and iodide) in water.

**Impact:** Provide tools for effective disinfectant residuals to control pathogen occurrences while minimizing DBPs in the distribution systems. Understand the overall relationships between pathogen occurrences and DBPs as it relates to OPPPs in DS and human health.



**Product POCs:** David Wahman and Darren Lytle (CESER)

**Internal Partners:** OW, OGWDW, Regions

**External Collaborators:** Local area hospitals and utilities, AWWA, Cincinnati Water Works

**Rules:** Disinfectants and DBPs Rules (DBPRs)



## SSWR 7.2.3: Exposure and Human Health Effects from Drinking Water Pathogens Found in Distribution Systems

**Problem:** Human health effects of OPPPs, especially those causing gastrointestinal and respiratory diseases are still not well understood.

### Action:

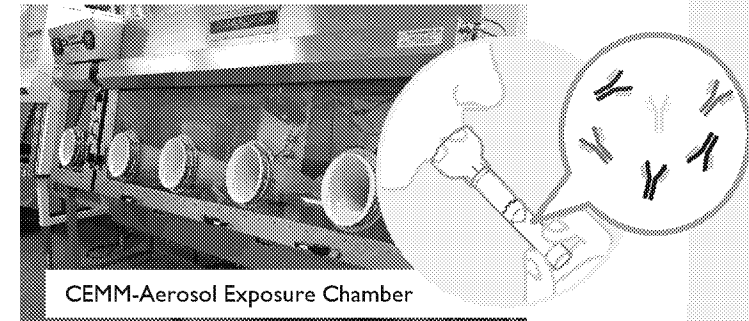
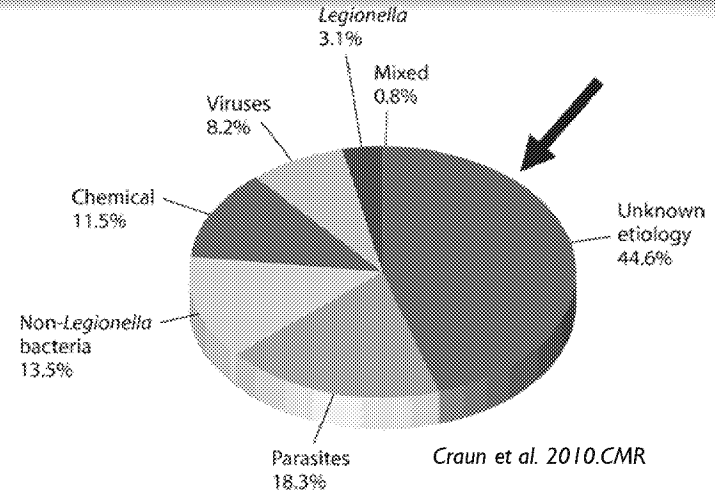
- ◆ Understand prevalence/incidences of OPPPs-associated disease burden in endemic regions, especially in underserved communities with inadequately treated water.
- ◆ Determine occurrences and human health effects of OPPPs in the system (e.g., storage tanks, cisterns, and POU devices) in emergency/non-emergency scenarios.
- ◆ Establish dose response models for various OPPPs found in DS.

### Result:

- ◆ Established the Aerosol Exposure Chamber facility to develop a dose-response model for inhaled *Legionella* (on-going).
- ◆ A salivary antibody immunoassay to measure human exposure to waterborne pathogens established. *Legionella* specific assays currently being evaluated (on-going).
- ◆ Occurrence of waterborne pathogens in rural communities receiving inadequately treated water in Puerto Rico initiated (on-going).

### Impact:

New tools/surveillance approaches to monitor OPPPs and their disease burden in communities; and improved quantitative microbial risk assessment models to assist in establishing more effective BMPs that reduce health risks posed by *Legionella* and other OPPPs.



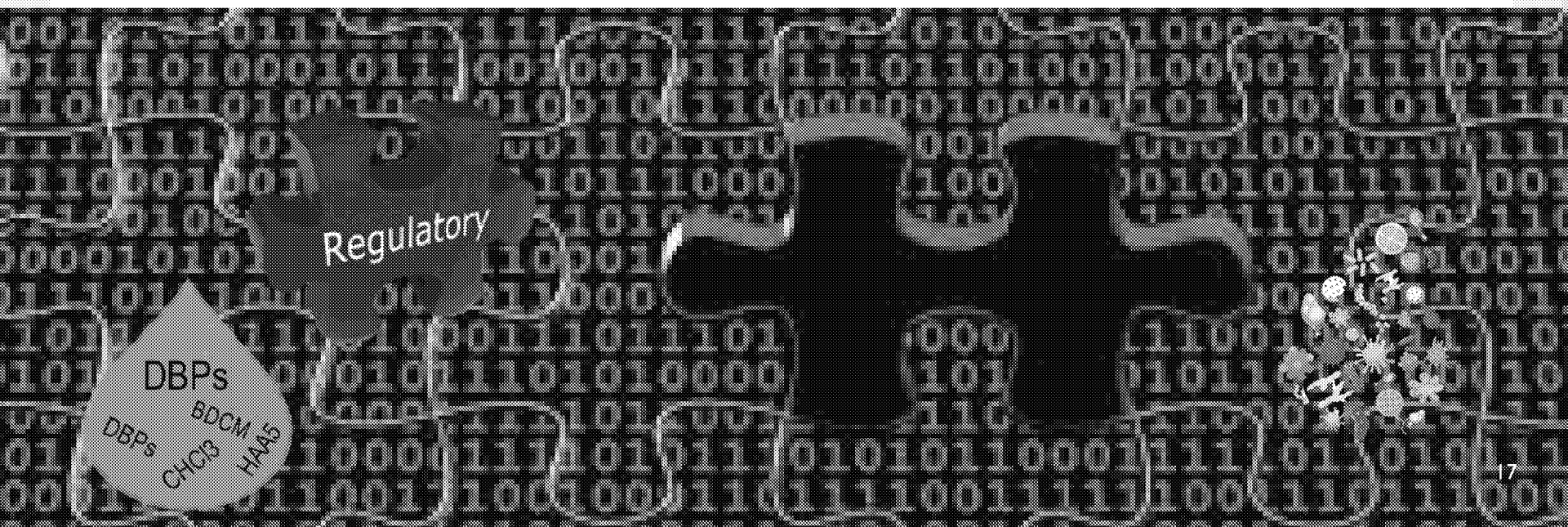
**Product POC:** Shannon Griffin (CPHEA)

**Internal Partners:** OGWDW, Region 2/6

**External Collaborators:** AWWA, APHA

# Analytical Methods, Occurrence, Health Effects, and Treatment Assessments to Aid Regulatory Decision Making

Lead: Jane Ellen Simmons





## SSWR 7.3.1: Predictive Computational Tools to Group Chemicals, Determine Joint Toxicity and Components Driving Risk and Improve Estimation

**Problem:** Program offices, states, and communities need improved computational methods to inform future DBP, Contaminant Candidate List, and Unregulated Contaminant Monitoring Rule decisions.

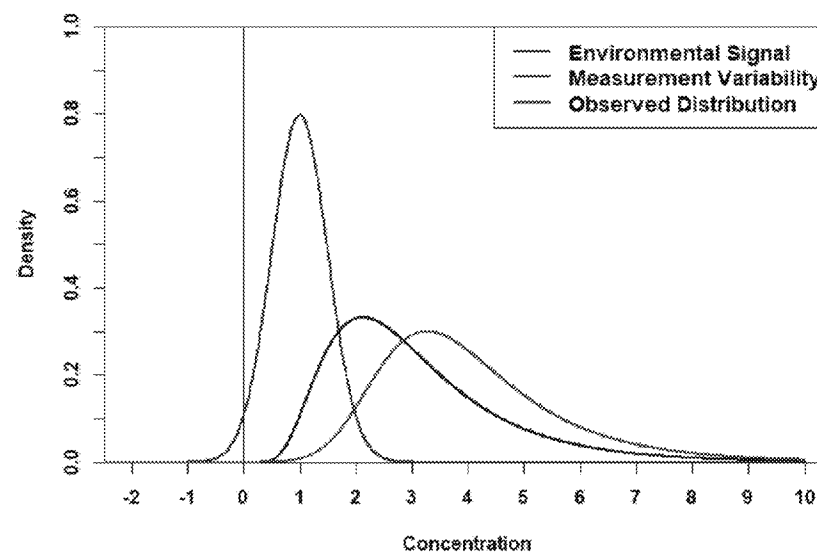
**Action:** Develop methods and models for robust estimation and prediction of contaminant occurrence, toxicity, and risk.

### Results:

- ◆ Increased understanding of the impact of key statistical analysis decisions.
- ◆ Best practices to guide use of improved methods and models.
- ◆ Predictive models of combined exposure and cumulative toxicity.
- ◆ Determination of effect drivers.

**Impact:** Reduced bias and improved precision in estimation and model predictions; effect driver identification, fit-for-purpose grouping methodology, predicting toxicity of chemical mixtures/groups.

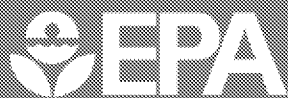
Lognormal Signal + Normal Measurement Variability



**Product POCs:** B.J. George and Jane Ellen Simmons (CPHEA)

**Internal Partners:** OST and OGWDW

**Rules/Other:** CCL, UCMR monitoring, DBP Rules, Chemical Contaminant Rules, Risk Assessment Methods



## SSWR 7.3.2 Decreasing Uncertainty in Regulatory Decision Making

**Problem:** Lack of knowledge on unregulated emerging chemical and microbial contaminants increases uncertainty in regulatory decision making.

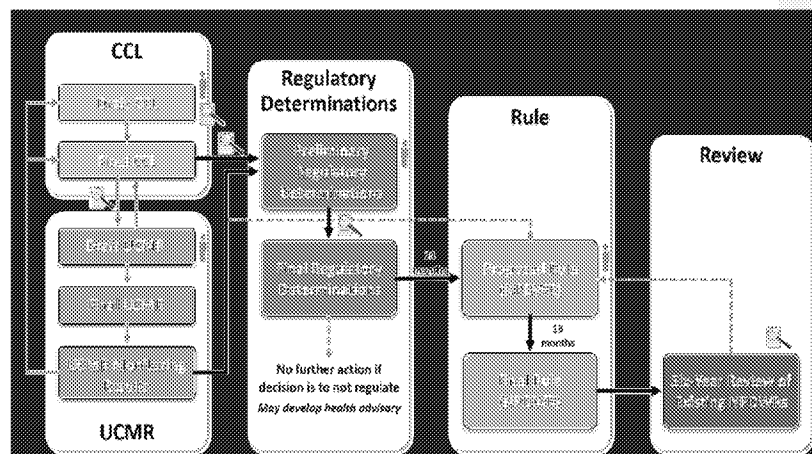
**Action:** Develop updated information on integrated dosimetry models of multi-route and multi-contaminant exposures, the evaluation of the importance of metabolism and the impact of susceptibility factors on dosimetry and toxicity, and quantitative methods for CCL priority pathogens.

### Results:

- ◆ Improved understanding of the need to consider multi-route (oral, dermal, inhalation) and multi-contaminant exposures.
- ◆ Improved understanding of how xenobiotic metabolism and susceptibility factors impact toxicity and dosimetry.
- ◆ Development and use of experimental methods to evaluate key developmental endpoints observed in epidemiologic studies.
- ◆ Improved assessment methods for detection and quantification of priority pathogens including those on CCL and those that may be considered for future UCMR monitoring.

**Impact:** This product will provide OW with updated information to fill research gaps that impede/prevent regulatory determination.

### SDWA – Process for Developing Drinking Water Standards



**Product POC:** Hodon Ryu (CESER)

**Internal partners:** OGWDW, OST

**External collaborators:** CDC

**Rules/Other:** CCL development, UCMR monitoring



## SSWR 7.3.3 Filling Key Knowledge Gaps to Support and Enhance Regulatory Decisions for Chemical and Microbial Contaminants: I. Chemicals

**Problem:** Critical data gaps increase uncertainty in regulatory decision-making and prioritization of contaminants either regulated or potentially regulated under the SDWA.

**Action:** Provide methods and models linking occurrence and effects information to aid OW, regional partners, and states in meeting EPA regulatory responsibilities under the CCL, UCMR, and 6-Year Regulatory Review mandates of the SDWA Amendments.

### Results:

- ◆ Toxicokinetic and toxicodynamic data to inform identification of key DBPs and adverse outcome pathways contributing to DBP-associated bladder cancer.
- ◆ New data and analyses that will improve our understanding of the impact of alternative treatments on health endpoints.
- ◆ Assessments of dermal impacts of water contaminants.
- ◆ Measurement methods for priority CCL and CEC contaminants.
- ◆ Evaluation of point-of-use filters for contaminant sampling.
- ◆ Occurrence data for the prioritization of chemical contaminants for future CCLs.

**Impact:** This product will provide OW with updated information to fill research gaps that impede/prevent regulatory determinations.

### *Balancing and Minimizing Chemical Risks*

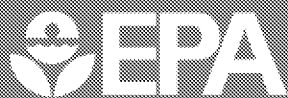


**Product POCs:** Rex Pegram (CCTE), Maura Donohue (CESER)

**Internal Partners:** OGWDW, OST

**External collaborators:** Water Utilities

**Rules/Other:** CCL, UCMR, DBP Six-Year Regulatory Review



## SSWR 7.3.3 Filling Key Knowledge Gaps to Support and Enhance Regulatory Decisions for Chemical and Microbial Contaminants: II. Microbial

**Problem:** Critical data gaps increase uncertainty in regulatory decision-making and prioritization of contaminants either regulated or potentially regulated under the SDWA.

**Action:** This product will provide methods and models linking occurrence and effects information to aid OW, regional partners and states in meeting EPA regulatory responsibilities under the CCL, UCMR, and 6-Year Regulatory Review mandates of the SDWA Amendments.

### Results:

- ◆ Validate analytical methods for CCL microbes for the next round of UCMR5/6 sampling- microbial.
- ◆ Method Comparison (culture and molecular) -*Legionella* and NTM.-UCMR.
- ◆ Examine Haloacetic acids (HAAs) and trihalomethanes (THMs) occurrence/toxicity with CCL microbes- SDWA and DBP rules.

**Impact:** Provide OW with updated information: filling data gaps that impede/prevent regulatory determination; and/or help strengthen or amend current rules.

### *Balancing and Minimizing Chemical Risks*



**Product POCs:** Maura Donohue (CESER) and Rex Pegram (CCTE)

**Internal Partners:** OGWDW, OST

**Rules/Other:** CCL, UCMR



## SSWR 7.3.4: Innovative Approaches for Evaluating Exposure to and Toxicity from Chemical Mixtures

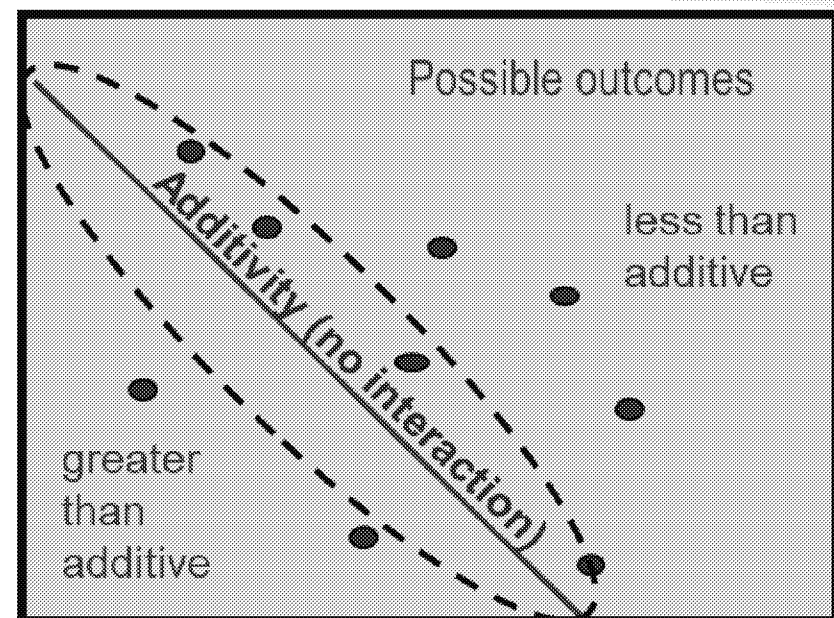
**Problem:** Program offices, states, and communities need improved exposure methods and computational toxicological methods for chemical mixtures to inform regulatory decisions.

**Action:** Development, application, evaluation of innovative tools to evaluate exposure to and toxicity from exposure to chemical mixtures.

### Results:

- ◆ Characterization of the ability of gene-expression biomarkers to distinguish different mixtures.
- ◆ Evaluation of the consistency of the in vivo toxicity of trihalomethane mixtures to proportional response addition predictions.
- ◆ Consideration of the utility of these two approaches for different mixtures.

**Impact:** New tools for determining risk posed by chemical mixtures.



**Product POCs:** Jane Ellen Simmons (CPHEA) and Adam Biales (CCTE)

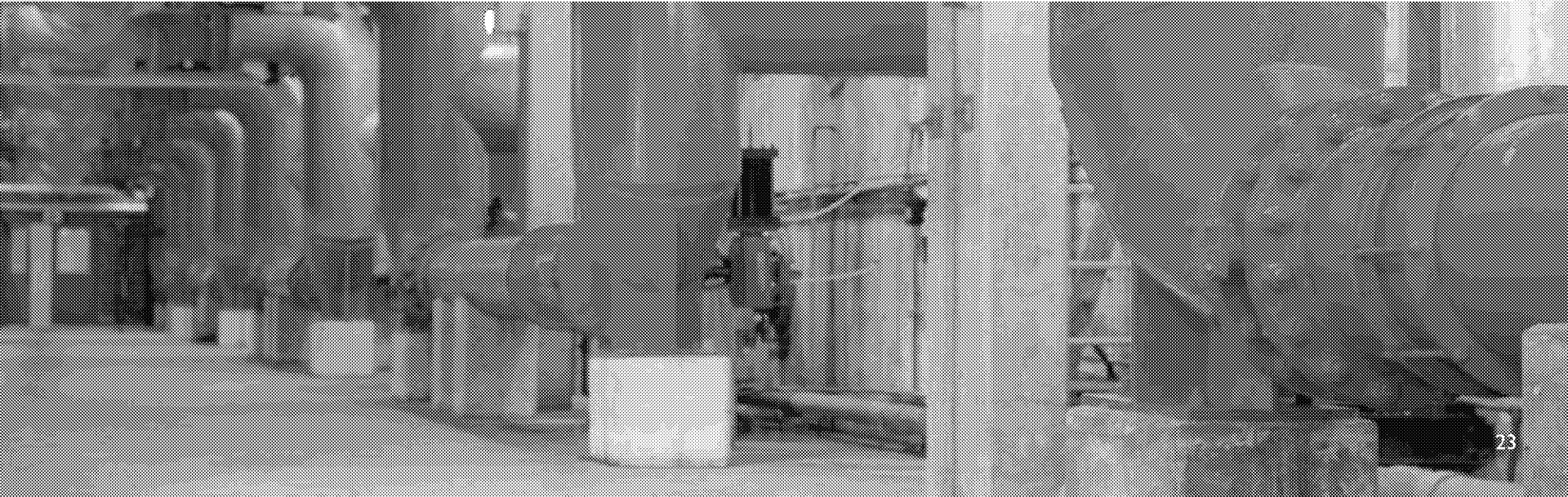
**Internal Partners:** OGWDW

**External Collaborators:** Consultants

**Rules/Other:** DBP Rules, CCL, Chemical Contaminant Rules, Risk Assessment Methods

# Resources and Tools Toward a Systems Approach for Maintaining Drinking Water Infrastructure Performance and Integrity

Lead: Regan Murray





# SSWR 7.4.1: Water Infrastructure and Water Quality Models to Improve Water System Performance and Estimate Exposure to Contaminants

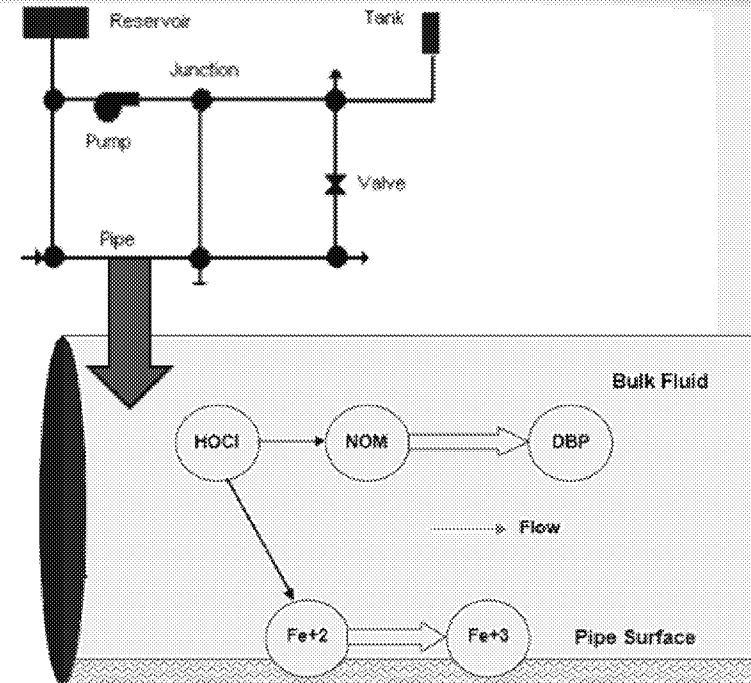
**Problem:** Improved water quality and hydraulic models are needed to support decision making at the community, state and regional level related to drinking water infrastructure and quality.

**Action:** The water quality component of the EPANET software will be updated to improve the ability of users to model complex reactions in drinking water and premise plumbing systems (e.g., DBPs). Experimental studies will be conducted to validate pressure and dispersion models contained within EPANET.

## Results:

- ◆ Improved multi-species water quality model for EPANET software with updated user interface, examples, and manual
- ◆ Development of 1D and 2D dispersion models for laminar flow regimes and studies to determine dispersion coefficients
- ◆ Experimental studies to validate pressure dependent demand models in EPANET

**Impact:** Updated systems analysis models, tools and information will be used by drinking water systems around the world to solve complex infrastructure and water quality issues.



**Product POC:** Feng Shang (CESER)

**Internal Partners:** OGWDW

**External Collaborators:** Argonne National Laboratories



## SSWR 7.4.2: Treatment Technologies to Meet the Needs of Small Systems

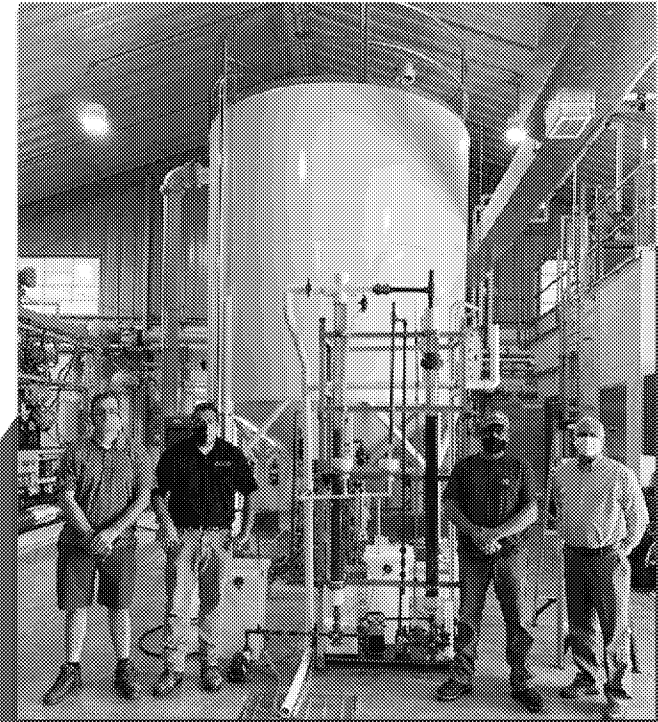
**Problem:** Small water systems have unique challenges including limited staffing, lack of specialized technical expertise, and fewer financial resources.

**Action:** Treatment technologies will be developed, modified and optimized to achieve the desired removal of regulated contaminants (e.g., nitrates) and contaminants of concern (e.g., manganese) in innovative and cost-effective ways. The technologies will be evaluated at the pilot scale and in full scale demonstrations in partnership with communities, EPA Regions, and states and territories, such as Iowa, Ohio, and Puerto Rico.

### Results:

- ◆ Pilot-scale biological treatment studies for ammonia removal
- ◆ Nitrate removal through anaerobic biological denitrification pilot
- ◆ Bench-scale evaluation of the reduction of nitrate by sulfur
- ◆ Demonstration of cost-effective technologies in Puerto Rico

**Impact:** This work will develop approaches that can be used sustainability by small systems nationwide.



**Product POC:** Dan Williams (CESER)

**Internal Partners:** Regions 2 and 5

**External Collaborators:** City of London, OH; state of Ohio; Puerto Rico

## SSWR 7.4.3: Water Distribution System Integrity and Performance Research

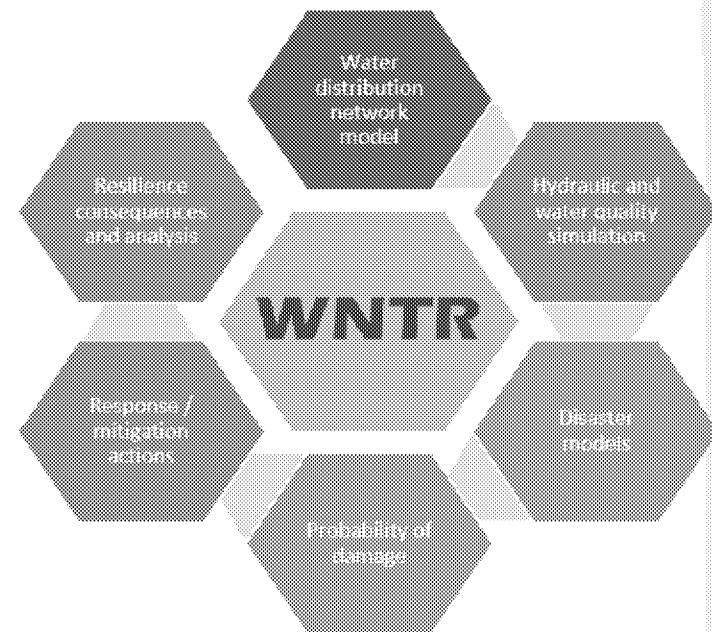
**Problem:** Faced with the challenges of aging infrastructure, natural disasters, environmental emergencies, and changes in water use, communities need tools to help prioritize infrastructure repairs.

**Action:** This product will develop an EPA website summarizing our applied science to improve drinking water infrastructure integrity, resilience, and performance, highlighting ORD research, tools, and data resources. In addition, case study publications will demonstrate the use of EPA tools to solve infrastructure problems.

### Results:

- ◆ Case study application of the Water Network Tool for Resilience (WNTR) for City of Pittsburgh
- ◆ Case study application of security tools with DC WASA
- ◆ EPA water system integrity and resilience website

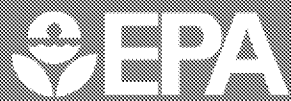
**Impact:** Information, data, and tools will be readily accessible to communities, states, and Regions.



**Product POC:** Robert Janke (CESER)

**Internal Partners:** OGWDW, R3

**External Collaborators:** Argonne National Laboratories, Sandia National Laboratories



# Questions?





# Charge Question I

The SSWR research program is implementing drinking water and distribution system research focused on lead/copper control, management of disinfection by-products (DBPs), and opportunistic pathogens. These issues are especially challenging for small systems and some environmental justice communities.

*What suggestion(s)/recommendation(s) does the Subcommittee have on ORD's implementation of its drinking-water and distribution research, and in particular on how these research activities can be comprehensively integrated to ensure safe disinfectant levels, while minimizing or eliminating exposure to lead, opportunistic pathogens, and DBPs in small treatment and distribution systems and in disadvantaged communities?*



Office of Research and Development

# SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM



**SSWR BoSC Meeting – May 26, 2021**  
**Research Area II: Technical Support**  
**Ben Packard, RA Coordinator**



# Technical Support



Provides timely technical support and outreach to EPA's Office of Water and regions, states, tribes, and communities needing help with challenges in drinking water, wastewater, stormwater, and water reuse areas.

**Engineering, scientific, and analytical support enabling ORD to respond to unplanned issues:**

- ◆ Technical support for lead, PFAS, cyanotoxins, and *Legionella*, amoeba, disinfection byproducts contamination in water systems. (Product POC: Jennifer Tully)
- ◆ Maintenance and training support for widely used stormwater, wastewater, and drinking water models. (Product POC: Robert Janke)
- ◆ Small systems challenges and solutions. (Product POC: Michelle Latham)





# Research Output 11.1

## Technical Support for Water Treatment, Analytical Methods, and Risk Assessments

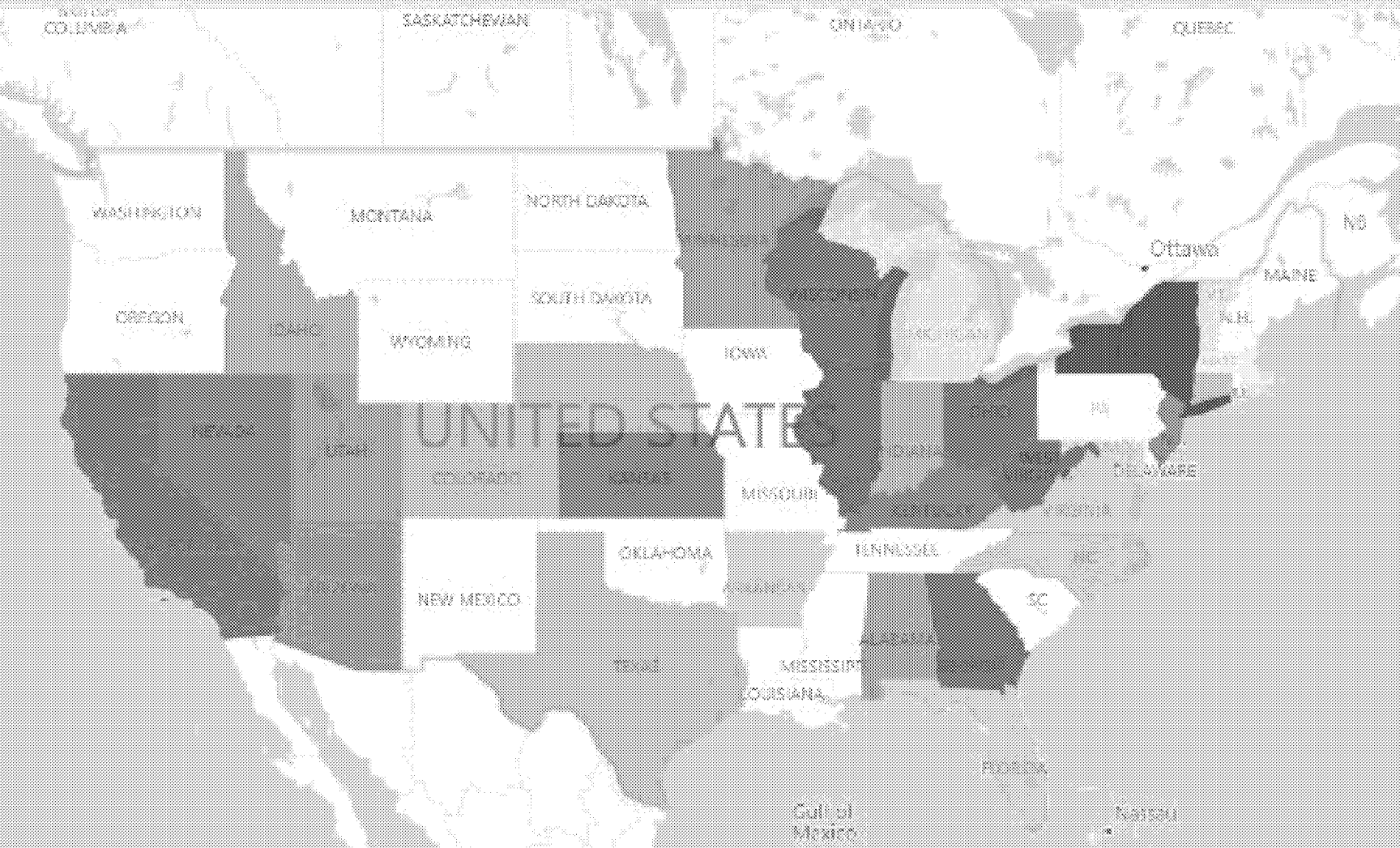
Lead: Craig Patterson





# Technical Support Examples

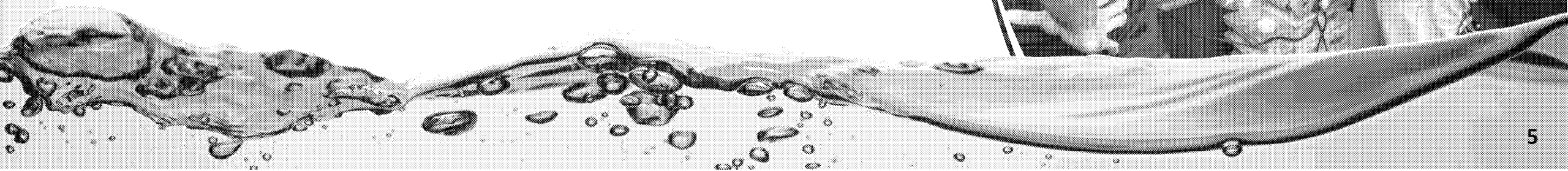
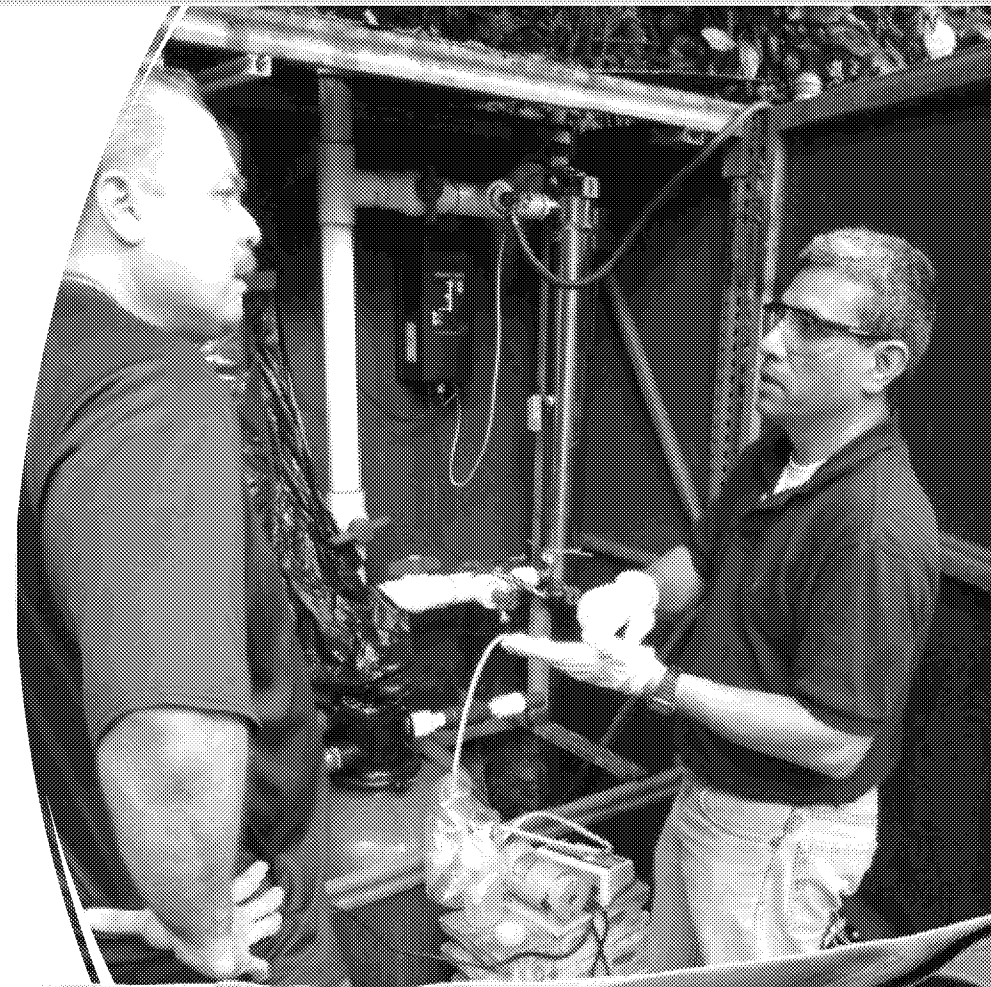
States Assisted



- ◆ **Corrosion Control for Lead:**  
Lead particle sampling in University Park, Illinois.
- ◆ **Harmful Algal Blooms:**  
Kansas Department of Health and Environment's 10th Annual HABs Workshop.
- ◆ **Emergency Response:**  
Ohio Coronavirus Wastewater Monitoring Network collaboration.
- ◆ **PFAS:**  
Removal effectiveness of granular activated carbon in Summerville, Georgia
- ◆ **Microbial Contaminants:**  
Kentucky permitting approval process for first UV disinfection system.

# Technical Support Examples

- ◆ PFAS stack testing at a pilot-scale incineration facility.
- ◆ PFAS removal study from groundwater with Ridgewood Water.
- ◆ Treatment tech support for Non-PRASA water systems in Puerto Rico.
- ◆ Updating ORD biosolid document: *Control of Pathogens and Vectors in Sewage Sludge*.





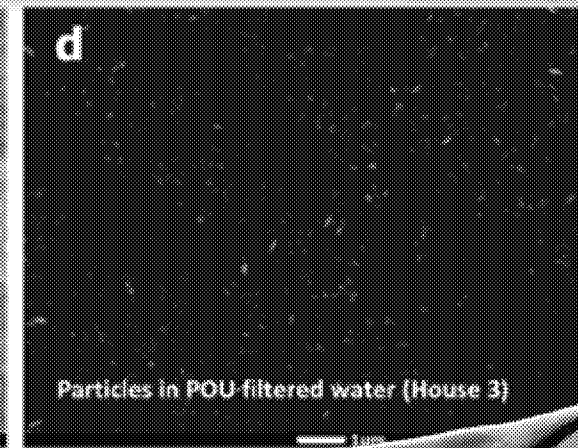
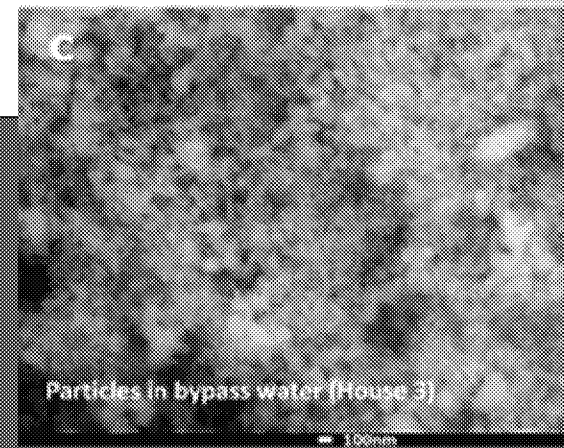
# Technical Support Highlight: Lead

## Lead particle size fractionation and identification in Newark, New Jersey

Efforts required deploying field teams, coordinating logistics of sampling and shipping, organizing analytical support to examine collected samples, data management/organization, communications, and the assembly of various ORD experts to evaluate the situation and resulting data

Publication in Environmental Science and Technology

Informed decisions made by the city related to long term improvements to corrosion control and point-of-use filters to remove lead.





# Technical Support Highlight: COVID-19 in Wastewater

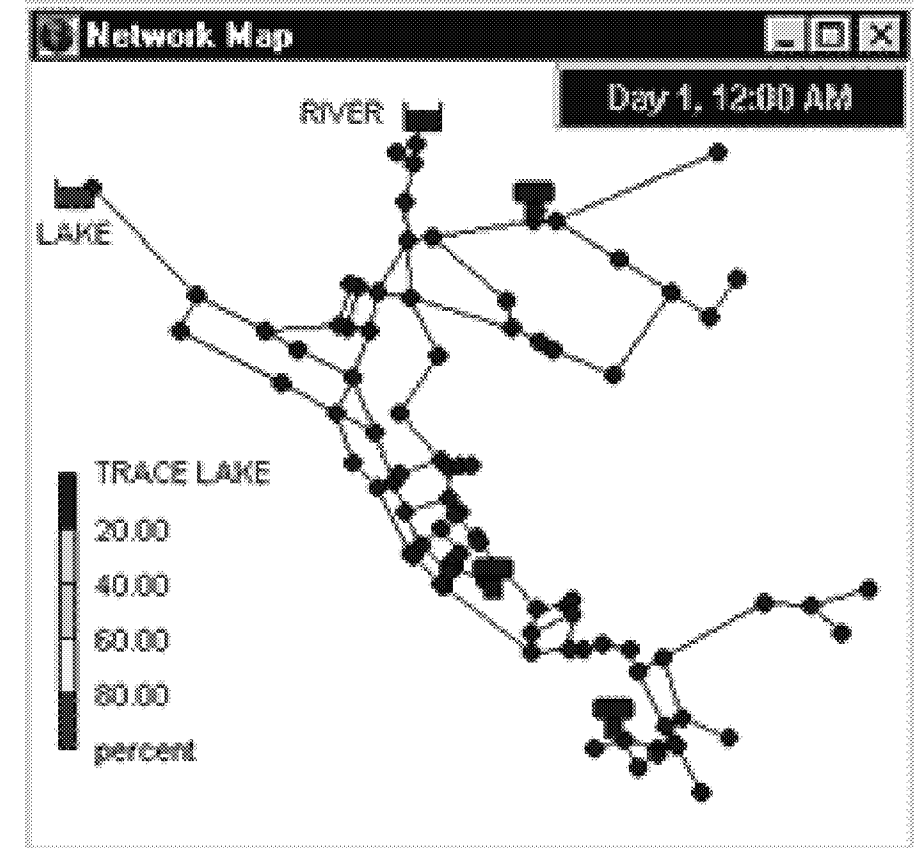
- ◆ Assisting the state of Ohio and the City of Cincinnati with implementing wastewater surveillance methods for the early detection of SARS-CoV-2.
- ◆ Collecting sewage samples, analyzing for the virus and for new variants.
- ◆ Improving analytical detection methods and sharing with communities around the world.

[Results on Ohio COVID-19 Dashboard](#)



# Model Maintenance and Support

- EPANET and related models
- Storm Water Management Model (SWMM)
- National Stormwater Calculator (SWC)
- Drinking Water Treatability Database (TDB)
- Water Treatment Plant (WTP) Model
- Environmental Technologies Design Option Tool (ETDOT)
- Free Chlorine and Cyanuric Acid System (FCCAS) Simulator Models



# EPANET and EPANET Models

- ◆ Downloaded 50,000 times per year from the [EPA website](#) by engineers, consultants, students, researchers, and water utility staff around the world.
- ◆ Used to support decision making for water infrastructure projects, water quality problems, energy savings, and planning for future scenarios.
- ◆ ORD released EPANET 2.2 (including User Manual) on July 24, 2020, which included major updates to the hydraulic and water quality engines, through an open-source collaborative [software development project](#).
- ◆ Continued to provide technical support and provide training at conferences.
- ◆ Support for the development of an updated graphical user interface (GUI) for EPANET-MSX.



## Storm Water Management Model (SWMM)

- ◆ 47,740 downloads in FY20.
- ◆ 76 technical support requests (51 from the US, 25 non-US): 2 citizens, 34 students, 7 professors, 22 professionals, 6 municipalities, 4 states, and one USAID (since Aug 2020).
- ◆ Two major upgrades resulting in five significant new features.
- ◆ Preparing major update (SWMM 5.2.0) with expected release by Fall, 2021.

## National Stormwater Calculator (SWC)

- ◆ National Fish and Wildlife Foundation has multiple resiliency grant programs, where they highly encourage grant applicants to use the SWC for their application. This is occurring in SE Michigan and Long Island Sound.
- ◆ Future public deployment of updated SWC web application.





# Treatment Models and Tools

## Drinking Water Treatability Database (TDB)

- ◆ Updated with 11 new PFAS chemical in May 2021.
- ◆ 4,000+ hits/month (academics, water utilities, first responders, consulting engineers, and regulators).

## Water Treatment Plant (WTP) Model

Recently updated with EPA Office of Water

## Environmental Technologies Design Option Tool (ETDOT)

- ◆ Made freely available through agreement with Michigan Technological University
- ◆ Evaluate systems for the removal of contaminants, including PFAS, from drinking water and wastewater.

## Free Chlorine and Cyanuric Acid System (FCCAS) Simulator Models

Four web-based applications used to simulate disinfectant chemistry



- 💧 Workshops and In-Depth Training
- 💧 Monthly Webinars
- 💧 eLearning
- 💧 Technical Communications and Outreach Workgroup

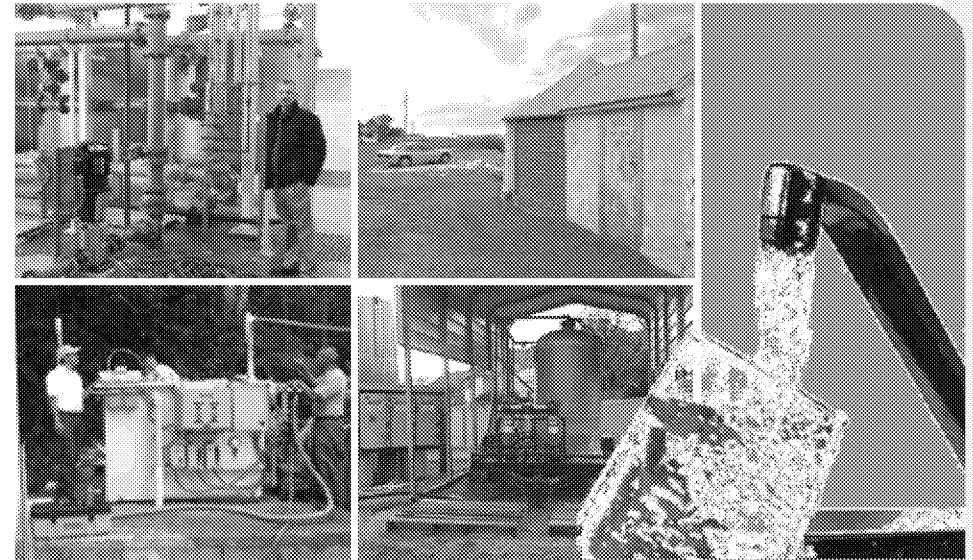




# Annual Drinking Water Workshop

## Small System Challenges and Solutions

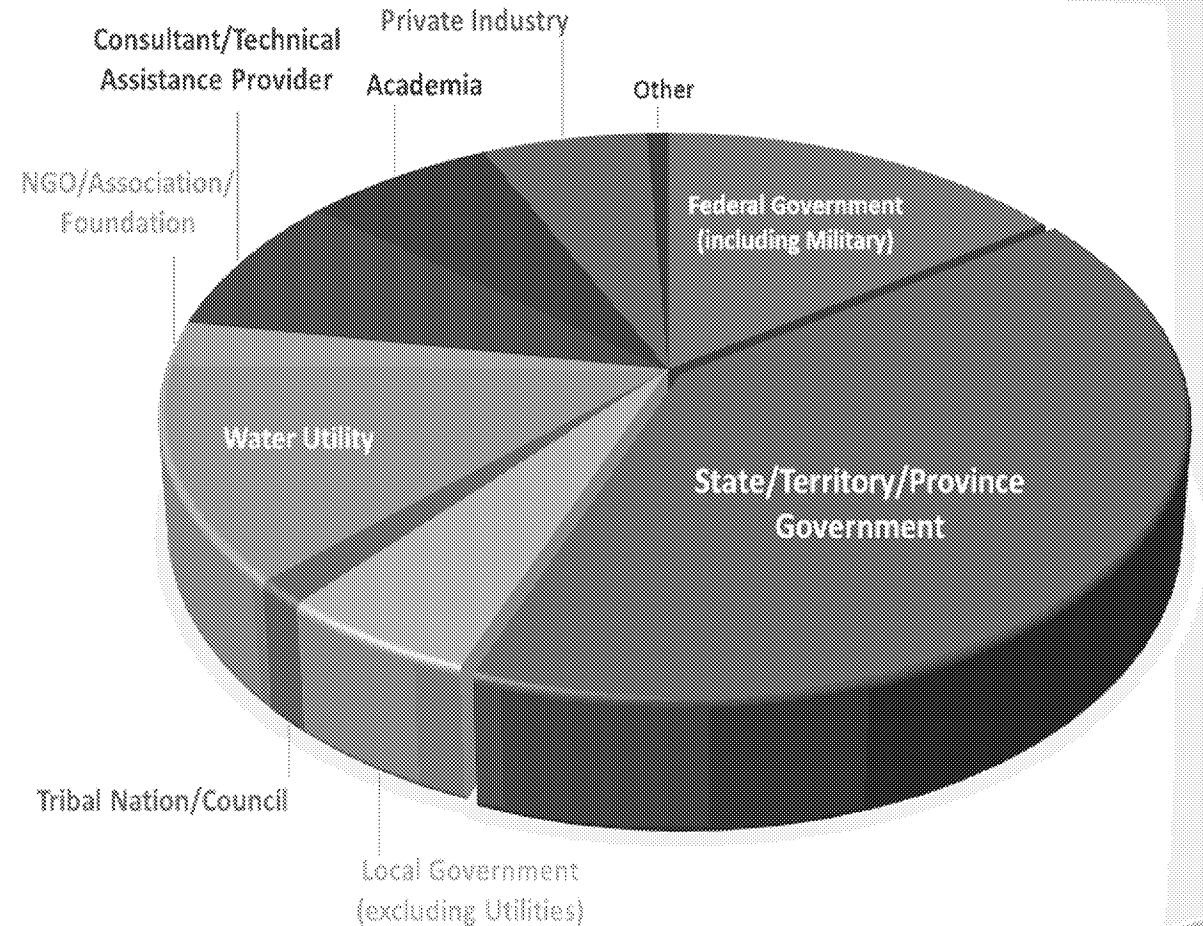
- 💧 In-depth training
- 💧 Technical sessions with Q&A
- 💧 Breakout focus groups
- 💧 Networking
- 💧 Demos and posters
- 💧 Training course credits
- 💧 Virtual sessions and recordings



EPA Office of Research and Development and Office of Water, in partnership with the Association of State Drinking Water administrators (ASDWA,) has held the annual workshop for the past 17 years.  
(typically held in the Greater Cincinnati Area)

## Over 3,300 attendees

- All 50 states and 5 territories
- 126 environmental and health agencies from all 50 states/DC, 4 territories, and 9 Canadian provinces
- 34 tribal nations/councils from 13 states and 1 Canadian province
- 248 water utilities from 41 states/DC and 4 other countries





# Annual Drinking Water Workshop (Virtual)

## Agenda and Recordings for the 17th Annual EPA Drinking Water Workshop (Virtual)

The 17th Annual EPA Drinking Water Workshop, held in partnership with the Association of State Drinking Water Administrators (ASDWA), took place virtually on August 31-September 3, 2020. The workshop provided in-depth information and training on solutions and strategies for handling small drinking water system challenges with a focus on monitoring, distribution, source, and treatment topics. Technical and communications and outreach breakout focus group discussion sessions were offered.

The 2021 virtual workshop is currently being planned for August 30-September 2, 2021. [Visit the 18th Annual EPA Drinking Water Workshop webpage for details.](#)

Links to the technical and training session recordings are provided in the agenda below. Certificates cannot be provided for viewing recordings.

2020 Agenda
<ul style="list-style-type: none"><li>• <a href="#">Monday, August 31</a></li><li>• <a href="#">Tuesday, September 1</a></li><li>• <a href="#">Wednesday, September 2</a></li><li>• <a href="#">Thursday, September 3</a></li></ul>
<ul style="list-style-type: none"><li>• <a href="#">Downloadable Agenda</a></li></ul>

The following links exit the site [Exit](#)

## 2020 workshop recordings

### Monday, August 31

11:00 am - 3:00 pm	<i>Concurrent pre-workshop in-depth training sessions (T1-T3)</i>
11:00 am - 3:00 pm (4 Contact Hours)	<b>T1. IN-DEPTH TRAINING: Sanitary Surveys, Filtration and Disinfection</b> This training was intended for water professionals, state drinking water program staff, and technical assistance providers that conduct sanitary surveys. This half-day training focused on evaluating filtration and disinfection technologies, including alternative treatment technologies as part of a sanitary survey. Presentations included examples from surveys and exercises. There were opportunities for open discussion among participants and Q&A with the presenters.

and Andrea Trivaglia, EPA-Per

## 18th Annual EPA Drinking Water Workshop: Small System Challenges and Solutions

### Date and Time

Monday 08/30/2021 11:00AM EDT to  
Thursday 09/02/2021 5:30PM EDT

[Add to Calendar](#)

### Location

Virtual Workshop (details coming soon)

### Details

EPA's free annual drinking water workshop, held in partnership with the Association of State Drinking Water Administrators (ASDWA), will take place on August 30 - September 2, 2021. The workshop will be virtual again this year and will provide in-depth information and training on solutions and strategies for handling small drinking water system challenges with a focus on monitoring, distribution, source, and treatment topics. Although we will miss the in-person workshop, we look forward to providing networking and training opportunities in a virtual setting for a large audience.

### Agenda and Registration – Coming Soon!

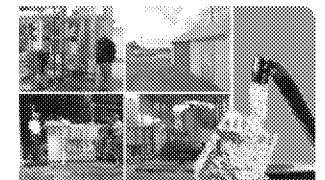
The virtual workshop speakers and group leaders will be experts in their fields from EPA and other federal agencies, state and local agencies, tribes, academia, and NGOs and associations. At a minimum, the workshop agenda will include the following:

- Technical presentation sessions
- In-depth training
- Breakout discussion groups

## 2021 workshop information

### Receive Notification When Registration Opens

We'll let you know when registration for the workshop opens.  
[Submit an email notification form](#)

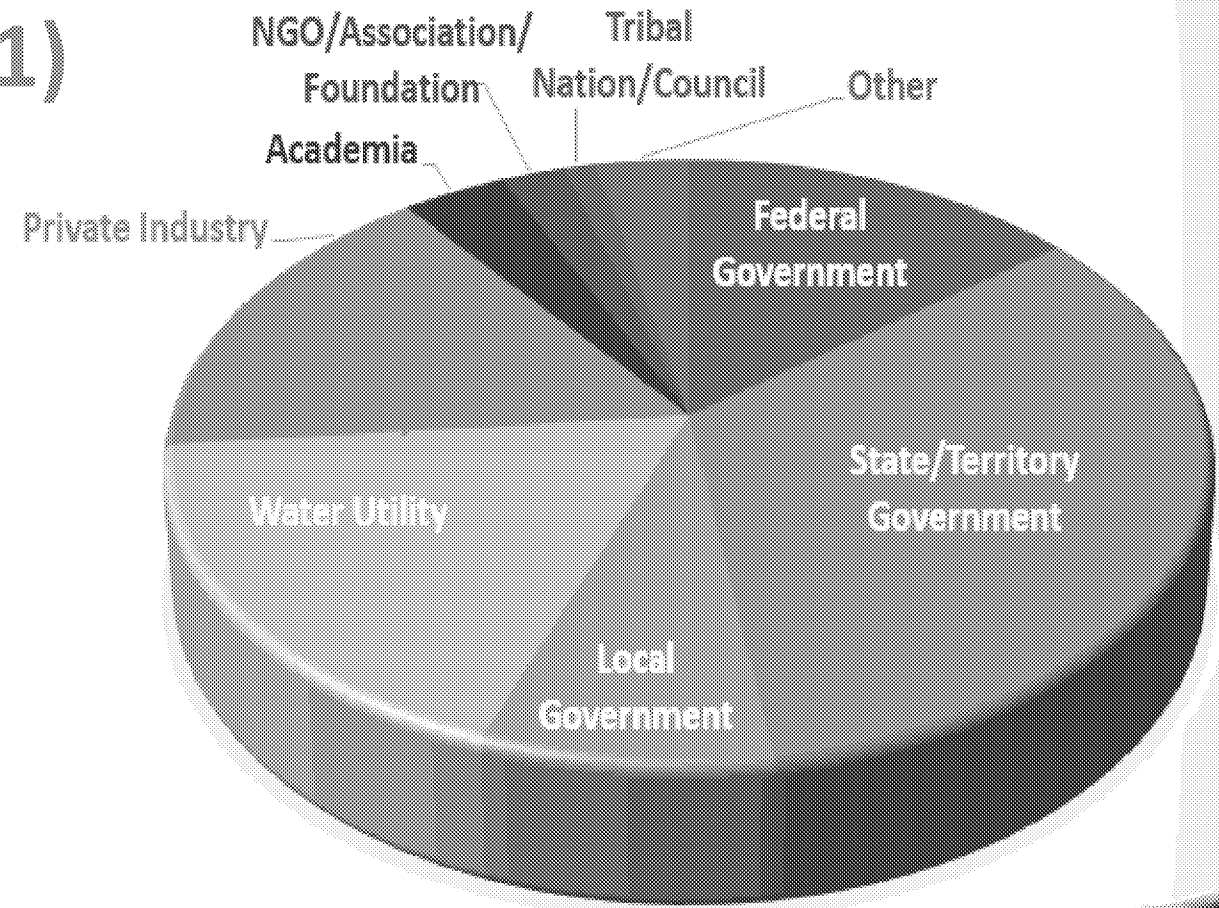




# Small Drinking Water Systems Monthly Webinar Series

Over 19,000 attendees (FY20-21)

- All 50 states/DC and 5 territories
- 75 other countries
- 65+ tribal nations/councils
- 13,800+ training hour certificates





-



# Questions?





Office of Research and Development

## SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM



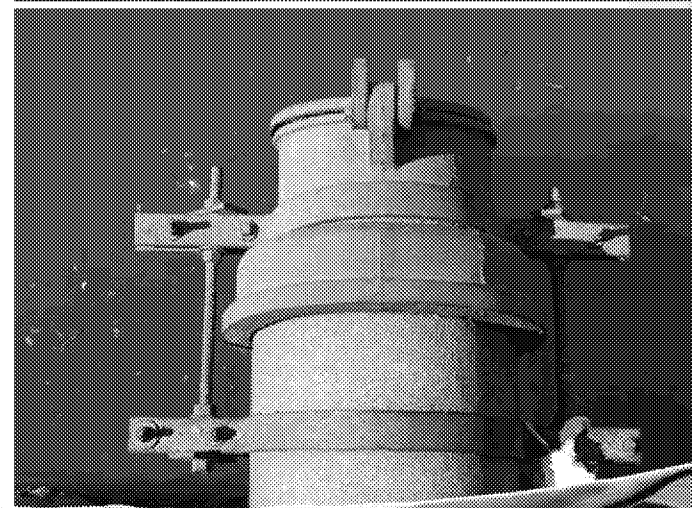
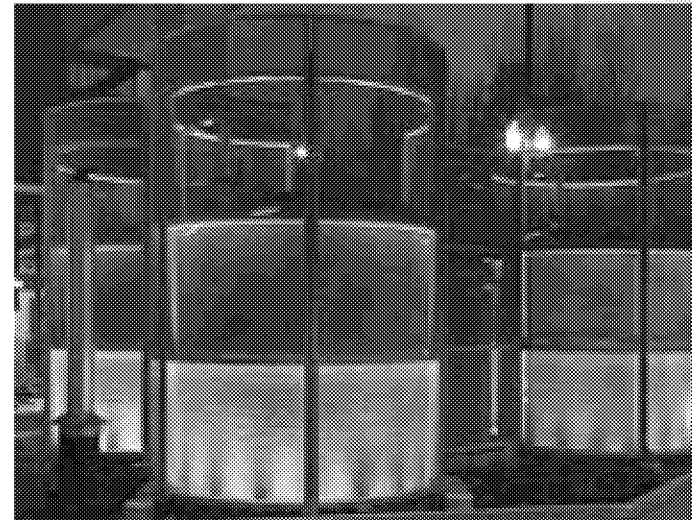
**SSWR BoSC Meeting – May 27, 2021**  
**Research Area 9: Wastewater/Water Reuse**  
**Ann Grimm, RA Coordinator**



## Background

- ◆ Microbial and chemical contaminants continue to be an issue for wastewater and water reuse treatment processes.
- ◆ Emerging issues, such as SARS-CoV2 and antimicrobial resistant bacteria, need further research to minimize risk to human health and the environment.
- ◆ New innovations in treatment processes and approaches for risk management can improve the quality of discharged and recycled water.

Water reuse research will focus on fit-for-purpose applications for several sources and end uses. Wastewater research will include efforts to identify and quantify chemical and microbial contaminants in support of OWM and OST efforts in wastewater and biosolids.





# Water Treatment and Infrastructure

## Research Area 7

### Drinking Water/Distribution Systems

Provide essential results and tools to our customers for managing existing and future drinking water needs. Specifically, it focuses on areas of recent concern that require novel solutions.

## Research Area 8

### Per- and Polyfluoroalkyl Substances (PFAS)

Robust analytical methods for analyzing PFAS in water, solids, and tissue samples, and a centralized website for treatment and pretreatment recommendations for wastewater and reuse.

## Research Area 9

### Wastewater/Water Reuse

Guidance on new and existing treatment technologies and analytical methods for emerging contaminants and contaminant risks.

## Research Area 10

### Integrated Stormwater Management

Integrated aspects of green/gray infrastructure and stormwater flow control to help states, municipalities, and utilities reduce the number of combined sewer overflows.

## Research Area 11

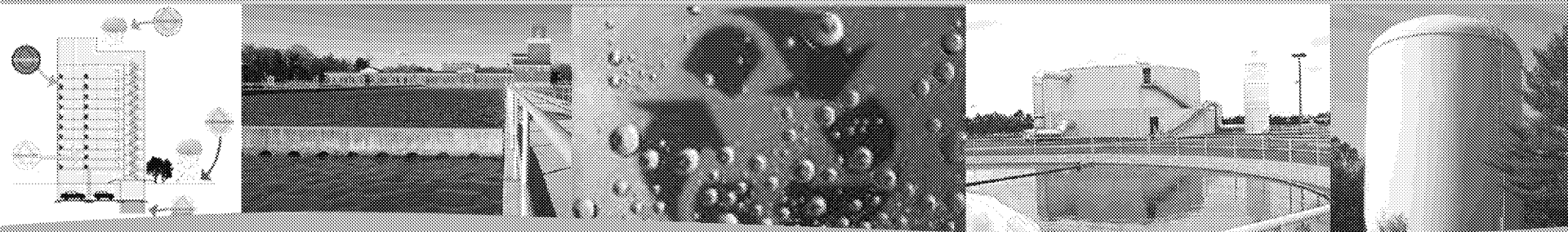
### Technical Support

Provide a means for rapid response to specific, unplanned program office, state, tribe, and community research needs concerning high-priority issues.





# Wastewater/Water Reuse



This research area will provide essential results and tools to the program offices, primarily the Office of Water, states, tribes, and communities to manage existing and future wastewater and Water Reuse issues.

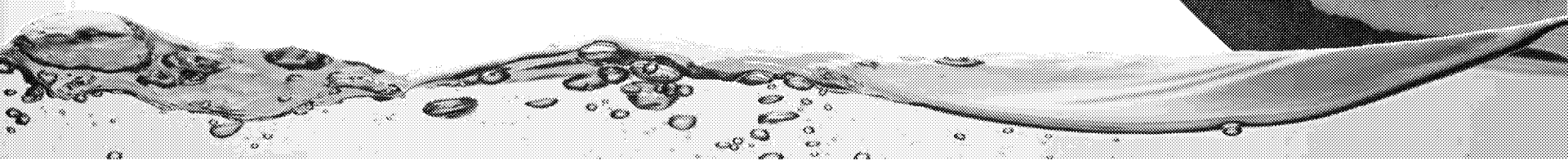
- ◆ **Agency Drivers:** CWA, National Pollution Discharge Elimination System requirements, state regulations, future regulatory determinations under SDWA and CWA.
- ◆ **Focus:** Areas of recent concern that require novel solutions.
  - SARS-CoV-2 and antimicrobial resistant bacteria
  - CECs
  - Fit-for-purpose water reuse



# Research Outputs Overview

**Output 9.1:** Analytical methods, exposure and effects assessment processes, and tools for wastewater and fit-for-purpose water reuse

**Output 9.2:** Treatment technologies for wastewater and fit-for-purpose water reuse

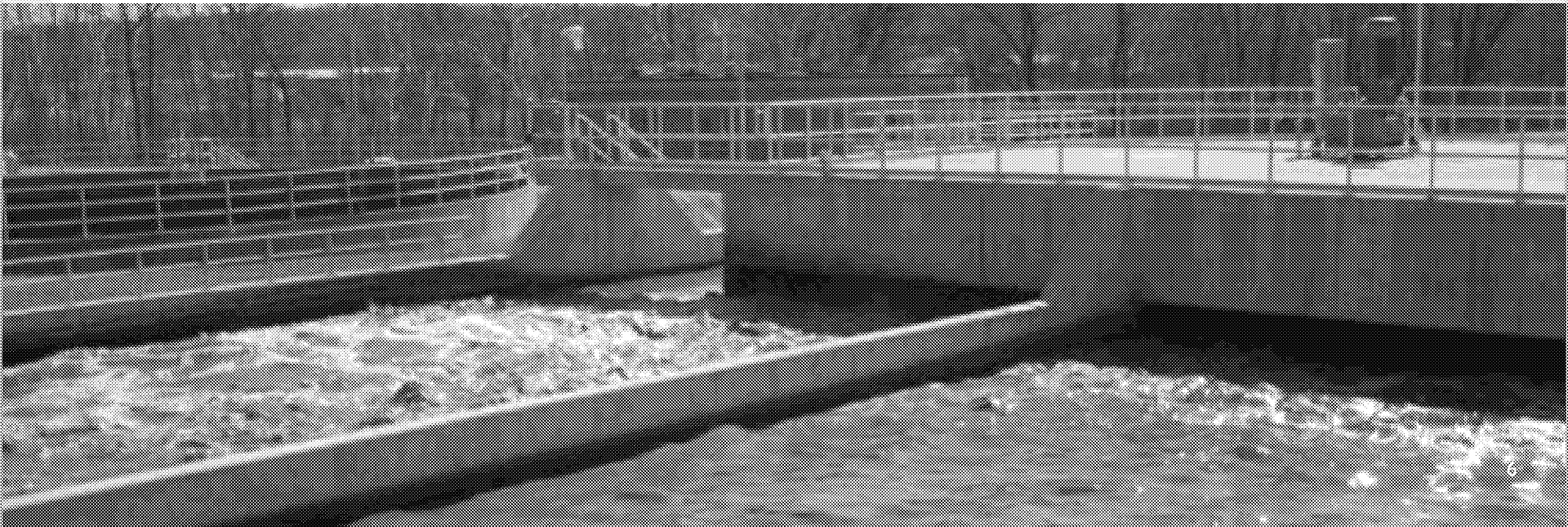


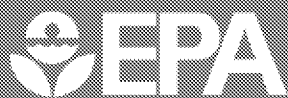


## Research Output 9.1

# Analytical Methods, Exposure and Effects Assessment Processes, and Tools for Wastewater and Fit-for-Purpose Water Reuse

Lead: Jay Garland





## SSWR 9.1.1: Effects-based Methods for Assessing Chemical Contaminants in Wastewater and Reclaimed Water

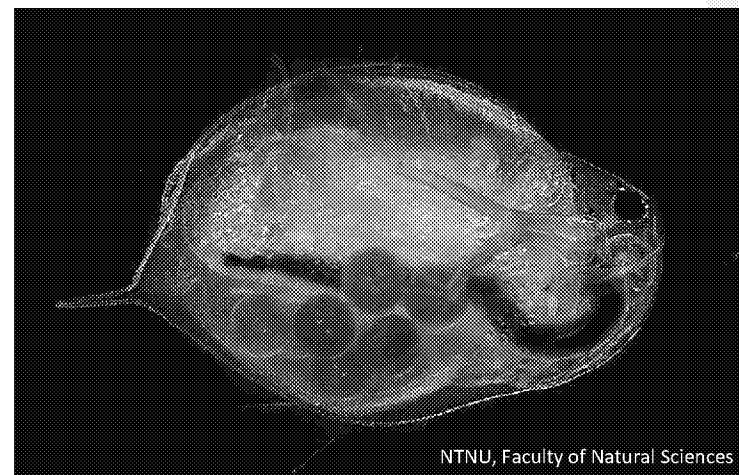
**Problem:** EPA Regional and Program Office (PO) partners need updated test methods for evaluating quality of water with potentially complex contaminant mixtures.

**Action:** Develop updated whole effluent toxicity (WET) tests for consideration for multi-laboratory validation by PO partners. Evaluate the use of innovative bioassays for screening water quality.

### Results:

- ◆ Draft WET tests for *Daphnia magna*, mussels (FY21). Future WET test development may focus on mayflies and trout.
- ◆ Single-laboratory validation for assay detecting thyroid disrupting activity in water samples.
- ◆ Endocrine disrupting activity screening in water samples with single-lab validated bioassays.
- ◆ Non-targeted analyses of WW for identifying chemicals of emerging concern (CEC).
- ◆ Fate of CECs in de facto water reuse (FY20).

**Impact:** Provide options for Regional/Program Office and state partners for evaluating the quality of wastewater effluents and recycled waters.



NTNU, Faculty of Natural Sciences

**Product POC:** Elizabeth Medlock-Kakaley (CPHEA)

**Internal Partners:** Laura Phillips (OW-OWM); Adrian Hanley, Colleen Flaherty (OW-OST)

**External Collaborators:** CA State Water Resources Control Board, SoCal Coastal Water Research Project, USGS



## SSWR 9.1.2: Quantifying Microbial Contaminants in Wastewater and Reclaimed Water

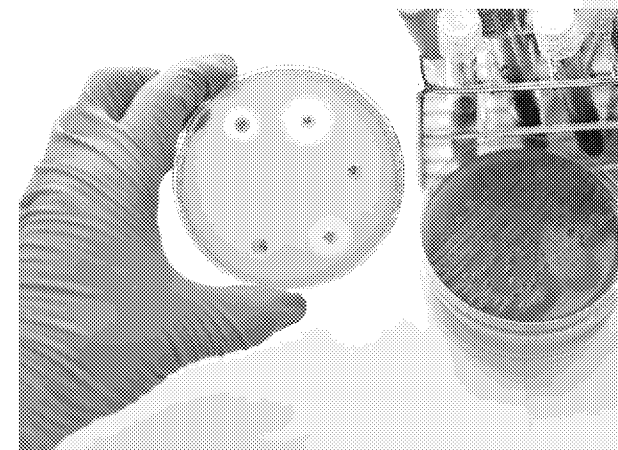
**Problem:** Pathogenic viruses are difficult to isolate and enumerate in WW and water reuse systems and, therefore, risk assessments for viable viruses are challenging. Emerging issues, such as antimicrobial resistant bacteria and/or genes (ARB/ARG) require rapid detection methods for risk assessment and management.

**Action:** Conduct research on innovative approaches for monitoring and enumerating virus and ARB/ARG in WW and recycled water.

### Results (Anticipated):

- ◆ Assessment of ARB/ARG loadings on WWTPs using molecular and cultivation-based assays and improving bacterial concentration methods.
- ◆ Develop a quantitative polymerase chain reaction panel for the broad-range analyses of ARB/ARG in WW.
- ◆ Evaluate sewer collection systems and treatment plants for dominant sources of ARB to WW.
- ◆ Monitor trends of SARS-CoV-2 in wastewater and evaluate methodologies
- ◆ Evaluation of the prevalence of ARB/ARG in biosolids and identify further research needs for managing ARB in biosolids.

**Impact:** Provide stakeholders with information and tools for managing viruses and ARB/ARG in WW treatment and collection systems and water reuse facilities.



**Product POC:** Eunice Varughese (CESER)

**Internal Partners:** Smiti Nepal (OW-OWM), Sharon Nappier (OW-OPME), Elizabeth Reseck (OW-OST)

**External Collaborators:** Patrick McDermott (FDA), USDA-ARS, CDC, Ohio Department of Health, Cincinnati MSD

## SSWR 9.1.3: Identification of Surrogates to Monitor Process Performance in Wastewater and Reclaimed Water

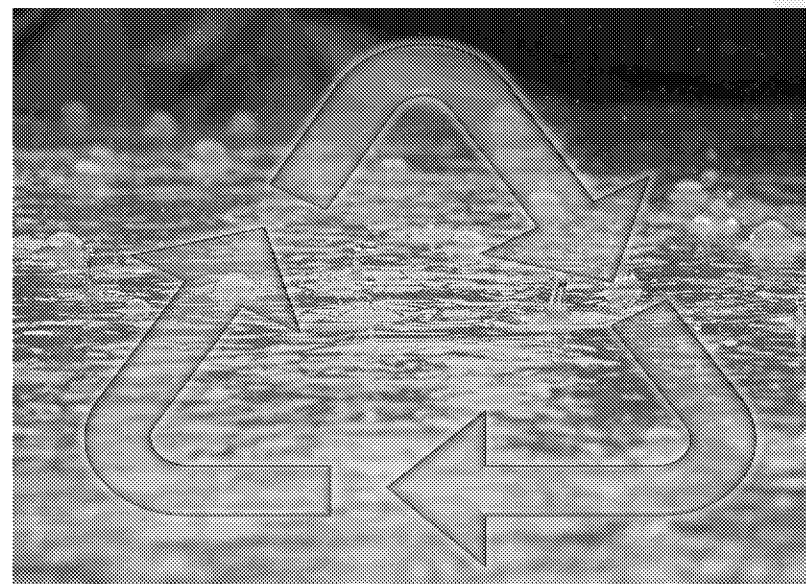
**Problem:** Viable pathogenic viruses and bacteria and CECs may cause deleterious effects in discharged or recycled waters at low concentrations. For many pathogenic organisms, detection is difficult and benchmarking management strategies challenging.

**Action:** Conduct research on surrogate organisms that can be easily quantified and correlate with low-concentration pathogens. Explore the application of surrogates to measuring treatment processes.

### Results (Anticipated):

- ◆ Quantify potential viral surrogates in source water of on-site non-potable reuse systems.
- ◆ Recommendations for bacterial and viral surrogates for monitoring on-site non-potable reuse systems.
- ◆ Develop non-targeted analyses workflows for WW and reuse.

**Impact:** Utilities will have resources to better monitor and manage treatment performance for removing pathogens and CECs.



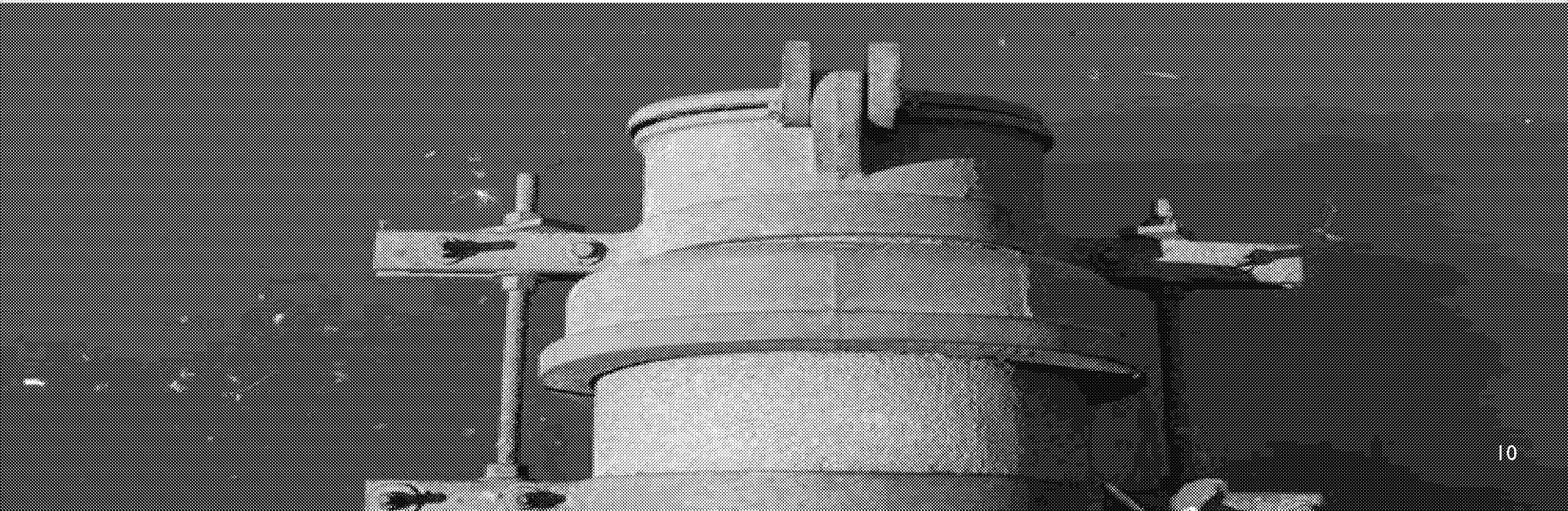
**Product POC:** Nichole Brinkman (CESER)

**Internal Partners:** Sharon Nappier (OW-OPME)

**External Collaborators:** National Blue Ribbon Commission for Onsite Non-Potable Water Systems, SFPUC, University of Colorado-Boulder, Colorado State University, WRF

# Treatment Technologies for Wastewater and Fit-for-Purpose Water Reuse

Lead: Jay Garland





## SSWR 9.2.1: Development of Risk-Based Guidance for Fit-for-Purpose Treatment and Reuse of Wastewater

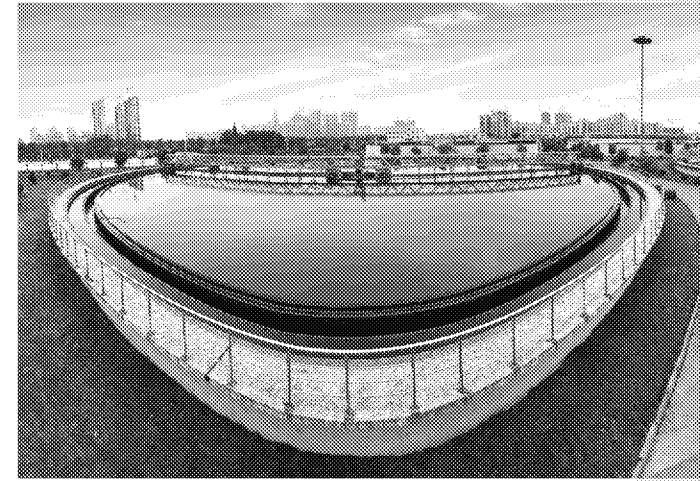
**Problem:** Communities considering fit-for-purpose water reuse lack robust risk-based quantitative assessments for implementation and often rely on conventional water quality indicators (e.g. coliforms).

**Action:** Develop risk assessment models to define treatment targets for relevant end uses.

### Results (Anticipated):

- ◆ Comparing risk-based water reuse approaches to those based on conventional water quality indicators.
- ◆ Blue Ribbon Commission report documenting updated pathogen log reduction targets for onsite non-potable water systems.
- ◆ Reports providing risk-based guidance for industrial water reuse, e.g. protein processing and oil and gas production.
- ◆ Report on water quality of air conditioning condensate and guidance for its onsite non-potable use.
- ◆ Incorporation of antimicrobial resistance into risk assessment models.

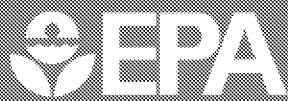
**Impact:** Provide communities with frameworks to implement fit-for-purpose water reuse.



**Product POC:** Michael Jahne (CESER)

**Internal Partners:** Sharon Nappier (OW-OPME), Smiti Nepal (OW-OWM), Tricia Pfeiffer (R8)

**External Collaborators:** National Blue Ribbon Commission for Onsite Non-Potable Water Systems, Tyson Foods, USDA



## SSWR 9.2.2: Optimization of Wastewater and Water Reuse Treatment Processes

**Problem:** Cost-effective, innovative technologies are needed for advancing WW and water reuse operations.

**Action:** Conduct research on alternative disinfection and treatment strategies for chemical and microbial contaminants.

### Results (Anticipated):

- ◆ State-approved field studies of PAA/chlorination and PAA/UV.
- ◆ Bench-scale proof-of-concept of tetraacetythylenediamine (TAED)-based peracetic acid (PAA) generation/delivery system.
- ◆ Performance evaluation of advanced disinfection processes, including Pilot/field testing of TAED-PAA system based on successful proof-of-concept, pilot scale evaluation of on demand PFA generation and disinfection system.
- ◆ Demonstration of a pilot scale MicroEVAP tested with laboratory prepared brines representative of RO concentrate streams, and actual brine solutions.

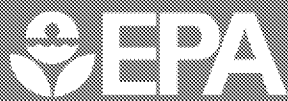
**Impact:** Provide stakeholders (wastewater treatment , desalination plants) with additional innovative tools and resources for WW and water reuse treatment.



**Product POC:** Jay Garland (CESER)

**Internal Partners:** Mohammed Billah (OW-OWM), Sharon Nappier (OW-OPME)

**External Collaborators:** Cincinnati Metropolitan Sewer District,, Lubrizol Advanced Materials, Inc., Kimera, Inc., Ohio EPA, Micronic Technologies, Inc.



## SSWR 9.2.3: Systems Analysis of Alternative Treatment Approaches

**Problem:** Communities considering alternative water management strategies, such as fit-for-purpose reuse, lack comparisons of costs/benefits between more conventional systems and alternatives, and design guidance.

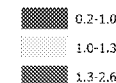
**Action:** Conduct research on sustainability and costs-benefits on alternative water management approaches.

### Results (Anticipated):

- ◆ Integrated sustainability assessment of mixed wastewater and graywater decentralized treatment for non-potable reuse (NPR).
- ◆ Develop an online calculator to aid decision-making for NPR from alternative sources at building scales.
- ◆ Integrated assessment for ozone/biological activated carbon and reverse osmosis-advanced oxidation for direct potable reuse.
- ◆ Analysis on energy expenditure distribution and the mechanism for paradigm changes in urban water systems to inform the optimization of system designs.

**Impact:** Provide communities with resources to aid decisions on alternative water management strategies and support National Water Reuse Action Plan (WRAP).

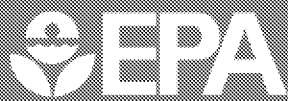
Composite  
Geographic  
Suitability  
Metric



**Product POC:** Cissy Ma (CESER)

**Internal Partners:** Sharon Nappier (OW-OPME), Smiti Nepal (OW-OWM), Mario Sengco (OW-OST)

**External Collaborators:** The National Blue Ribbon Commission; SFPUC, CA; Gwinnett County, GA; MSD/GCWW, OH; US Green Building Council; Water Reuse Association



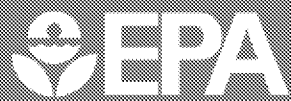
# Research Area 9 and the Water Reuse Action Plan

## ORD Leader/Co-leader

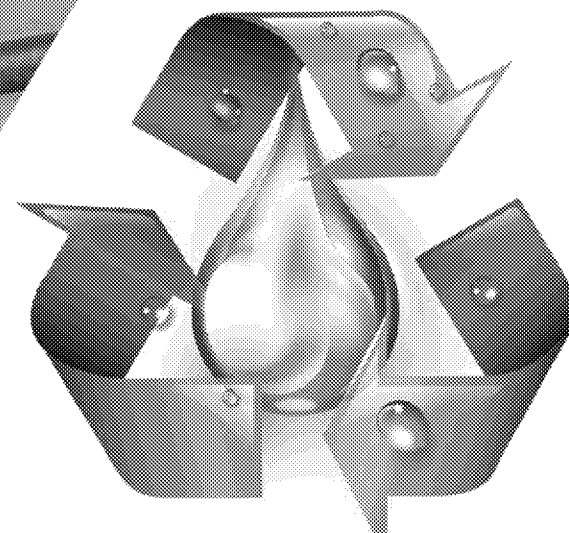
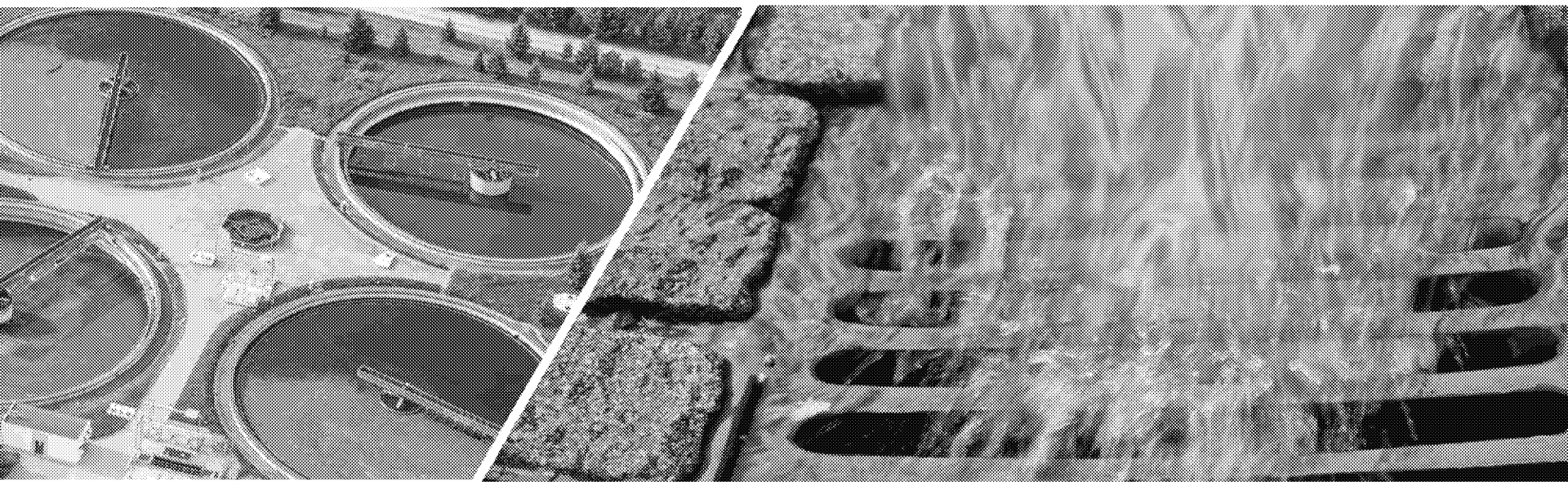
- ◆ 2.3.5 - Assess Specifications of Wastewater in Food Animal Protein Processing Facilities
  - EPA POC: Jay Garland (ORD)
- ◆ 2.4.5 - Support Air-Cooling Condensate Water Reuse in Large Buildings
  - EPA POC: Jay Garland (ORD) and Greg Eades (ORD)
- ◆ 2.7.5 - Coordinate and Promote Water Reuse Technology in Federal SBIR Programs
  - EPA POC: April Richards (ORD)
- ◆ *New Proposed Action* 2.3.6 - Viral Pathogen and Surrogate Approaches for Assessing Treatment Performance
  - EPA POC: Sarah Ludwig-Monty (ORD)

## Partner Led Action with ORD involvement

- ◆ 2.3.4 - Develop Research and Tools to Support ONWS (NBRC)
  - EPA POC: Jay Garland (ORD)
- ◆ 2.4.2: Implement New Mexico Produced Water Research Consortium to Identify and Fill Science and Technology Gaps for Off-Field Use of Treated Produced Water (NM Environment Department)
  - Michael Jahne ORD POC
- ◆ *New Proposed Action* 2.5.2 - Identify Monitoring Practices for Reuse Applications (WRF)
  - Elizabeth Medlock-Kakaley, Nichole Brinkman ORD POCs



# Questions?





# Charge Question 2

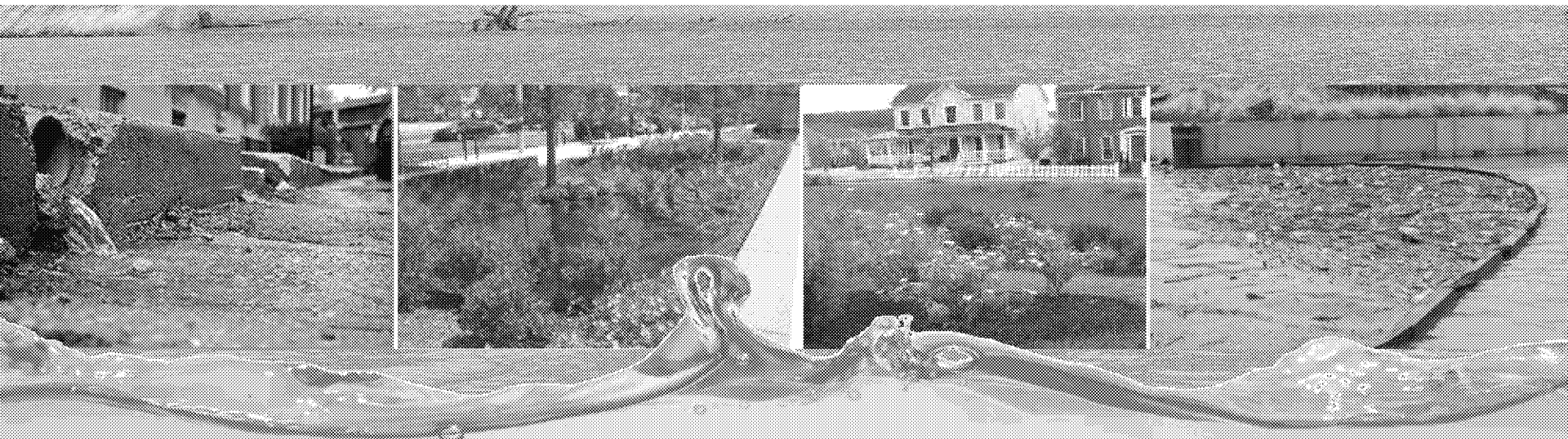
ORD water reuse researchers have worked closely with other organizations (e.g. Water Research Foundation) to avoid duplicative research, especially in large municipal direct potable reuse systems. This coordination led to SSWR implementing research focused on non-municipal sources of wastewater (e.g. industrial, agricultural) and decentralized non-potable end uses that can contribute to increased resiliency of water resources, especially in areas facing increased frequency, intensity, and duration of higher temperatures and drier climate patterns.

*Please comment on the implementation of ORD's water reuse research, and what suggestion(s)/ recommendation(s) does the Subcommittee have regarding SSWR's water reuse research for helping to innovatively augment water supplies and improve resiliency by identifying promising alternative water sources?*



Office of Research and Development

## SAFE AND SUSTAINABLE WATER RESOURCES RESEARCH PROGRAM



**SSWR BoSC Meeting – May 27, 2021**  
**Research Area 10: Stormwater**  
**Ann Grimm, RA Coordinator**



# Background



- ◆ Stormwater management issues continue to be a challenge for many communities in the US.
- ◆ Many combined sewer systems in the Northeast, Midwest, and Pacific Northwest need innovative methods for addressing discharge issues.
- ◆ Municipal Separate Storm Sewer Systems (MS4) need new approaches for managing water quality and quantity.

Stormwater research will integrate green and gray infrastructure to minimize stormwater effects on human health and the environment and will explore ways to capture stormwater for beneficial uses.





# Water Treatment and Infrastructure

## Research Area 7

### Drinking Water/Distribution Systems

Provide essential results and tools to our customers for managing existing and future drinking water needs. Specifically, it focuses on areas of recent concern that require novel solutions.

## Research Area 8

### Per- and Polyfluoroalkyl Substances (PFAS)

Robust analytical methods for analyzing PFAS in water, solids, and tissue samples, and a centralized website for treatment and pretreatment recommendations for wastewater and reuse.

## Research Area 9

### Wastewater/Water Reuse

Guidance on new and existing treatment technologies and analytical methods for emerging contaminants and contaminant risks.

## Research Area 10

### Integrated Stormwater Management

Integrated aspects of green/gray infrastructure and stormwater flow control to help states, municipalities, and utilities reduce the number of combined sewer overflows.

## Research Area 11

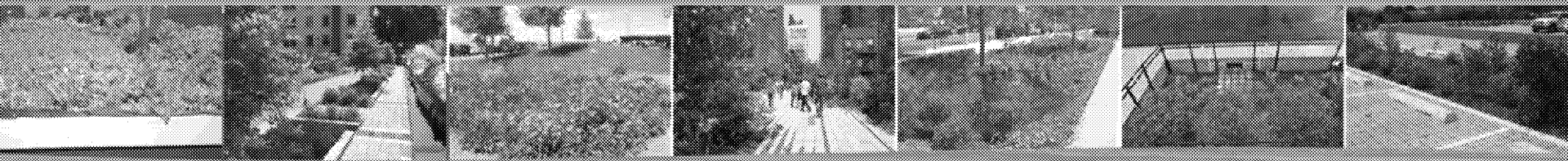
### Technical Support

Provide a means for rapid response to specific, unplanned program office, state, tribe, and community research needs concerning high-priority issues.





# Stormwater Management



This research area will provide essential results and tools to the program offices, primarily the Office of Water; states; tribes; and communities to better manage stormwater.

## Agency Drivers

Regulatory determinations under the CWA and SDWA (current and future), National Pollution Discharge Elimination System requirements, state regulations.

## Focus

Areas of recent concern that require novel solutions:

- ◆ Combined sewer overflows
- ◆ Monitoring stormwater infrastructure effectiveness and costs
- ◆ Enhanced aquifer recharge



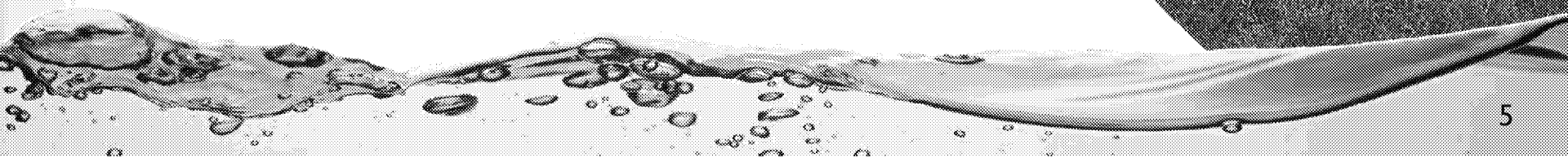
# Research Outputs Overview

## Output 10.1

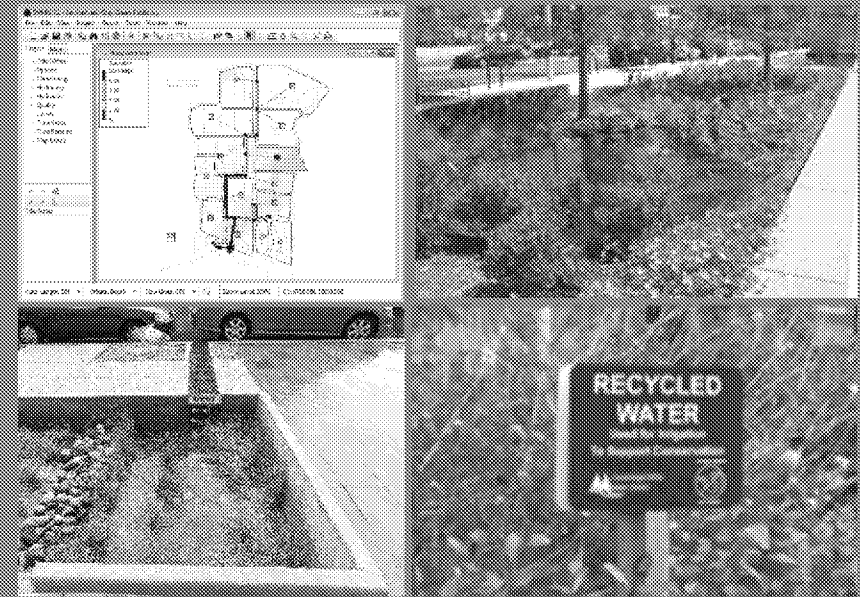
Planning, Implementing, and  
Monitoring Stormwater  
Management Practices

## Output 10.2

Stormwater Management as a  
Resource for Enhanced Recharge,  
Capture, and Use



Products from this work will help provide stakeholders with resources to monitor and manage stormwater, provide planners with tools for stormwater management strategies, and evaluate best practices for enhanced aquifer recharge.



- Optimization of the Stormwater Management Model (SWMM) for green/gray infrastructure planning.
- Monitoring strategies for evaluating water quantity and quality management.
- Report on best practices for stormwater capture and use through enhanced aquifer recharge and decentralized reuse.

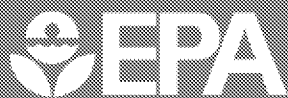


## Research Output 10.2

# Stormwater Management as a Resource for Enhanced Recharge, Capture, and Use

Lead: John Johnston





## SSWR 10.2.1: Recommendations for Water System Recharge to Aquifers

**Problem:** Stormwater is often seen as a nuisance rather than a resource.

**Action:** Conduct research to explore the possible use of stormwater for enhanced aquifer recharge (EAR).

### Results (Anticipated):

- ◆ Report on the state-of-the-science for EAR best practices.
- ◆ Costs/benefits of enhanced stormwater recharge.
- ◆ Comparisons of design, performance and maintenance issues for sink holes infiltration ponds, serial dams, spreading basins and drywells.
- ◆ Application of methods to evaluate impacts of EAR on groundwater quality.
- ◆ Treatment options for stormwater for EAR.

**Expected Outcome:** Recharged aquifers by providing stakeholders with stormwater best management practices.

### Product POC:

Doug Beak (CESER)

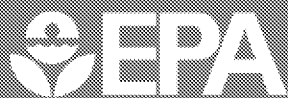
### Internal Partners:

Robert Goo, Sharon Nappier, Justin Mattingly (OW),  
Newton Tedder (R1), Elizabeth Ottinger (R3)



### External Collaborators:

Chickasaw Nation, Oklahoma DEQ, Oklahoma Water Resources Board, City of Ada Oklahoma, Oklahoma State U., USGS, USDA ARS, UC Riverside, UC Davis



## SSWR 10.2.2: Recommendations for Stormwater Capture and On-Site Use

**Problem:** Communities lack data on stormwater quality including chemical and microbial pollutants and how these pollutants vary by location.

**Action:** Characterize stormwater constituents as it flows through different environments (e.g., urban, rural) to apply risk-based assessments for reuse.

### Results (Anticipated):

- ◆ Evaluation of stormwater pathogen concentrations in urban and rural settings.
- ◆ Data on chemical pollutants in stormwater and potential impacts for reuse and EAR.
- ◆ Develop risk-based frameworks for decentralized stormwater use.

**Expected Outcome:** Provide communities with results and best practices for implementing stormwater capture and use.



### Product POC:

John Johnston (CEMM)

### Internal Partners:

Robert Goo, John Ravenscroft, Rachel Urban, Sharon Nappier, Amina Pollard (OW); Newton Tedder (R1); Elizabeth Ottinger (R3)



## SSWR 10.2.3: Modeling and Monitoring the Influence of Stormwater on Groundwater Quality and Aquifer Recharge

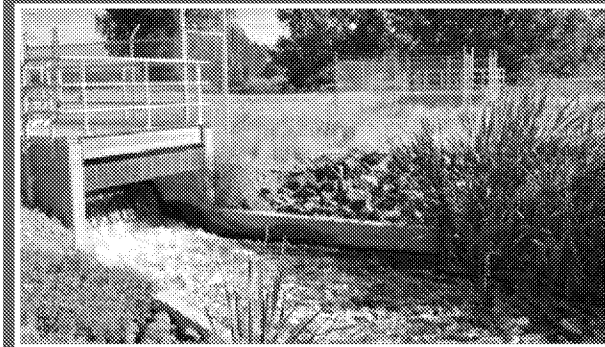
**Problem:** Data is lacking on potential stormwater effects on groundwater resources.

**Action:** Conduct research on subsurface interactions with stormwater. Evaluate the fate and transport of contaminants in stormwater and those present in the subsurface.

**Results:** Data from monitoring networks in different geological and climatological settings for evaluating contaminant behavior:

- ◆ Mixing infiltrate water with groundwater can cause groundwater changes; concentration of traditional stormwater contaminants did not pose a concern.
- ◆ Dilution of the groundwater could change the drinking water source chemistry and impact water treatment. Possible risk.
- ◆ Reverse ion exchange. Increased sodium loading on the fine-grained particles in the vadose zone could lead to clogging diminish infiltration and water movement.
- ◆ Solubility and mobility of barium affected by the concentrations of chloride. Enhanced mobility of some metals could be potentially problematic when chloride salts are applied as de-icing agents.
  - Development of models to evaluate stormwater best management practices for aquifer recharge.

**Expected Outcome:** Provide communities with information on contaminant movement and potential threats, or lack thereof, to groundwater resources.



### Product POC:

Doug Beak (CESER)

### Internal Partners:

Dawn Taylor (R4); Christopher Taylor (R7); David Albright, Matthew Small, Leslie Greenberg (R9); Robert Elleman (R10)

### External Collaborators:

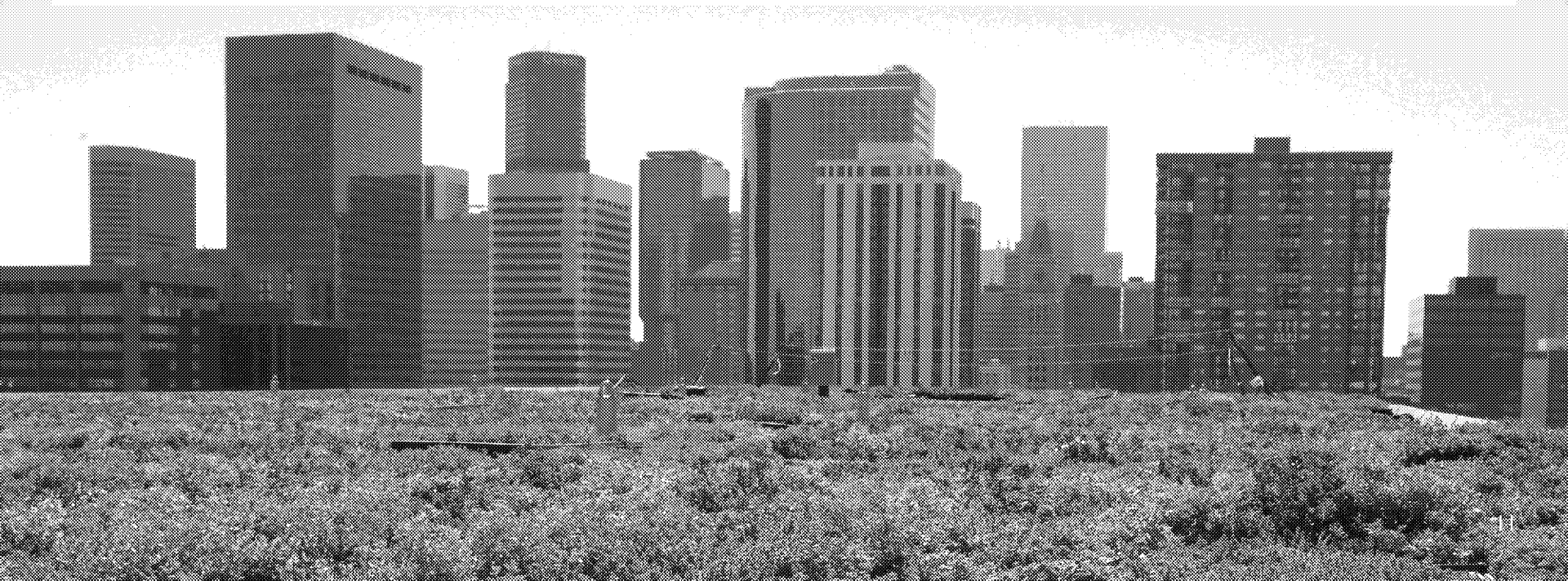
DoD, Army Corp of Engineers, Louisville and Jefferson County MSD, City of Yakima, County of Yakima, UC Riverside, USDA ARS, U. Arizona, USGS, California Water Science Center



## Research Output 10.1

# Planning, Implementing, and Monitoring Stormwater Management Practices

Lead: Matt Hopton





# SSWR 10.1.1: Recommendations for Planning, Monitoring, and Managing Stormwater

**Problem:** EPA Regional and Program Office (PO) partners, states, tribes, and municipalities need better approaches for evaluating stormwater management options prior to installation.

**Action:** Develop modeling and cost/benefit tools for comparing and evaluating management options for managing stormwater quality and quantity. Provide monitoring solutions for evaluating management strategies.

## Results (Anticipated):

- ◆ Cost/benefit tool (CLASIC) developed by WRF through STAR Grant.
- ◆ Report on the application of SWMM and other models (e.g., Visualizing Ecosystem Land Management Assessments, National Stormwater Calculator) to simulate green/gray infrastructure.
- ◆ Tools to design stormwater control approaches (e.g., size and cost-effectiveness).
- ◆ Integration of sensing technologies, communications, digital data tools, and machine learning for planning.
- ◆ Monitoring and tracking pollutants (e.g., road salt, pathogens).

**Expected Outcome:** Improved stormwater management in CSO and MS4 systems by providing management options and monitoring solutions to Regional/Program Office, state and tribal partners.

## Product POC:

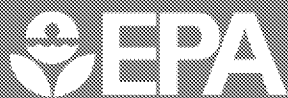
Paul Mayer (CPHEA)

## Internal Partners:

Jamie Piziali, Sharon Nappier, Robert Goo, Rachael Urban, Jenny Molloy (OW); Newton Tedder (R1); Elizabeth Ottinger (R3); Regina Poeske (R3); Matt Small (R9); Angela Adams (R10); Lewis Linker (CBPO)

## External Collaborators:

Department of Energy & Environment; WRF; Seattle; U of W Center for Urban Waters; Riverside County Flood Control and Water Conservation District; Southern CA Coastal Water Research Project; USGS; DOE; U of MN; NEORSD; City of Fairfield, Ohio; Urbanalta, Inc.; OKI Water Science Center; University of MD; Joseph Cotruvo and Associates; Essential Environmental and Engineering Systems



## SSWR 10.1.2: Recommendations for Stormwater Management Implementation and Performance

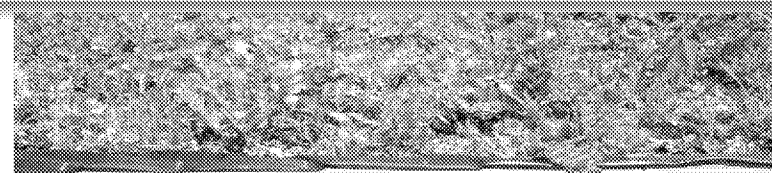
**Problem:** Stakeholders lack information on existing green infrastructure (GI) including efficacy, costs/benefits, and fate/transport of contaminants through GI.

**Action:** Conduct research on monitoring gray/green infrastructure and identifying best management practices that combine GI and gray infrastructure to minimize CSO events.

### Results (Anticipated):

- ◆ Summary document/website on models, tools, and best-management practices using green/gray infrastructure to eliminate urban CSOs.
- ◆ Development and validation of integrated infrastructure models with temperature/precipitation models.
- ◆ Evaluation of nitrogen fate and transport in urban stormwater.
- ◆ Report on practical methods for watershed management and community involvement for practical stormwater management implementation.

**Expected Outcome:** Reduced CSO events by providing stakeholders with tools for monitoring and optimizing stormwater management approaches.



### Product POC:

Ariamalar Selvakumar (CESER)

### Internal Partners:

Matt King, Stephanie Santell, Smriti Nepal (OW); Micah Bennett, Sydney Wiess, Danielle Green (R5); Veronica Fasselt (R4)

### External Collaborators:

USGS; DOE; WI Department of Natural Resources; FL State University; FL Escambia County, Environmental Management Division; Northeast OH Regional Sewer District; University of MN; Great Plains Institute; Monroe and Vernon County Conservationist; Village of Viola



## SSWR 10.1.3: Decision-Support Tools for Cost-Effective Community and Watershed-Scale Integrated Planning, Including Stormwater, Wastewater, Drinking Water Management, and Land-Use Conservation

**Problem:** Stormwater, wastewater, drinking water resource, and land use management are often stove-piped and not coordinated at the watershed scale, leading to higher costs and unintended consequences. Tools were not previously available to support EPA's integrated water management program.

**Action:** Develop tools for cost-effective integrated water management, including not only wastewater + stormwater, but also drinking water and land conservation.

### Results:

- ◆ EPA ORD has released multiple versions of the Watershed Management Optimization Support Tool (WMOST) with user guides, theoretical documentation, case studies, and training material.
- ◆ Optimization is now provided for both water quantity (water supply, flooding) and water quality (water quality standards, TMDL loads) goals.
- ◆ Dollar value of associated benefits and cobenefits of green infrastructure can be quantified with the new Benefits Module.

**Outcome:** Stakeholders have tools to find cost-effective solutions involving integrated water management at the small watershed scale (HUC12-HUC10). MDE has been trained in use of WMOST.

### Product POC:

Naomi Detenbeck (CEMM)

### Internal Partners:

Chau Vu (R1), Regina Poeske (R3),  
Christopher Taylor (R7)

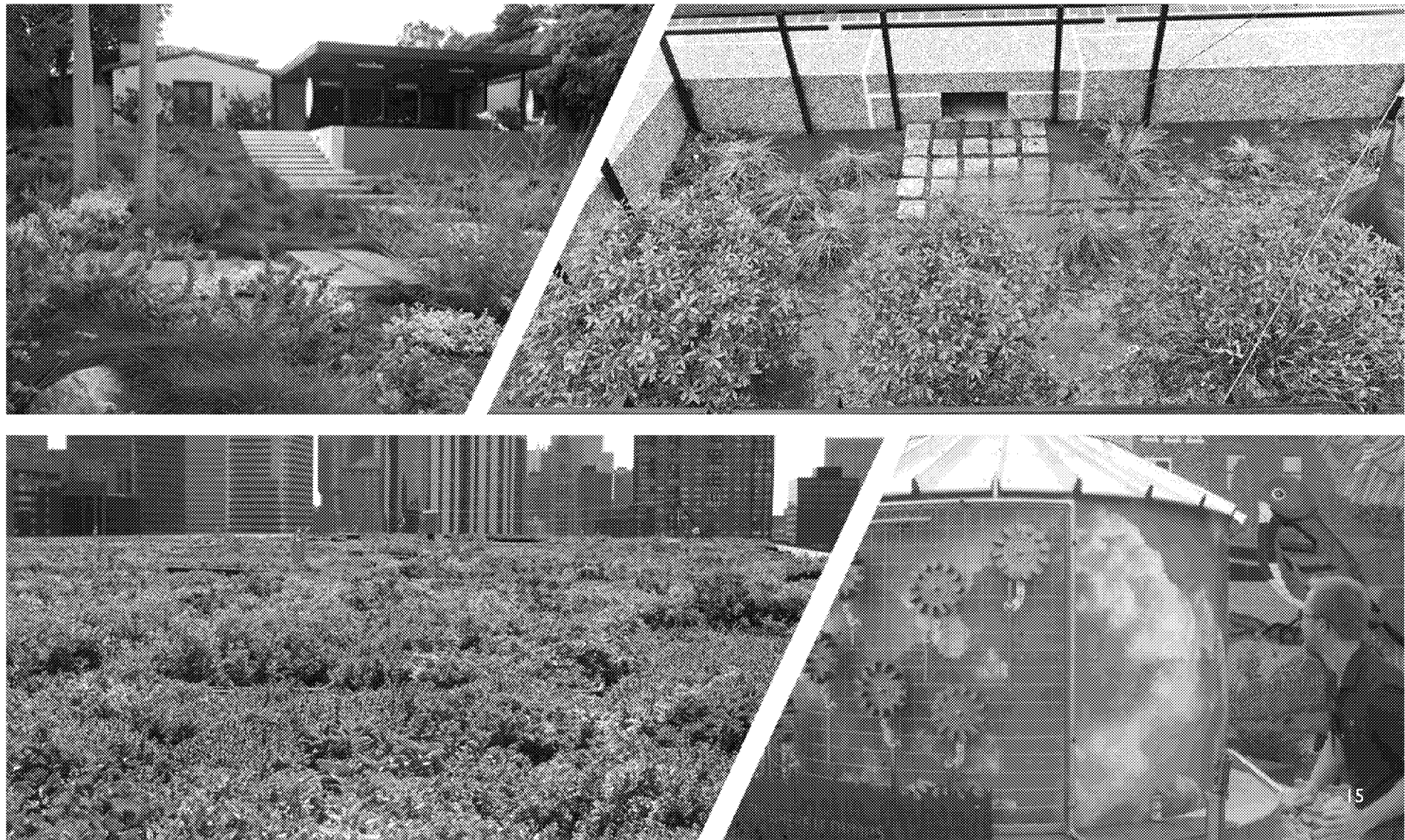


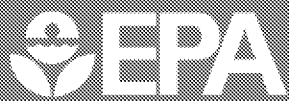
### External Collaborators:

MD Department of the Environment,  
Southeastern Regional Planning &  
Economic Development District,  
Resilient Taunton Watershed  
Network, KS Department of Health  
and Environment



# Questions?





# Charge Question 3

Stormwater management approaches can decrease stormwater runoff to wastewater treatment systems (combined sewer systems) and stream discharges (municipal separate storm sewer systems). Consequences from combined sewer systems frequently affect lower-income areas in urban settings. These effects may be exacerbated in areas subjected to increased intensity, duration, and frequency of extreme precipitation events.

*In addition to evaluating ORD's stormwater research activities, what suggestion(s)/recommendation(s) does the Subcommittee have to improve the utility of these research activities to provide integrated decision-support tools for stormwater management in disadvantaged communities?*

## SSWR.10.1.1

- ◆ Nissen, K. A., Borst, M., & Fassman-Beck, E. 2020. Bioretention Planter Performance Measured by Lag and Capture. *Hydrologic Processes*, 5176-5184. doi:<https://doi.org/10.1002/hyp.13927>
- ◆ Hoover, F.A., J.I. Price, and M.E. Hopton. 2020. Examining the Effects of Green Infrastructure on Residential Sales Prices in Omaha, Nebraska. *Urban Forestry & Urban Greening* 54:126778. doi:[doi.org/10.1016/j.ufug.2020.126778](https://doi.org/10.1016/j.ufug.2020.126778)
- ◆ Brumfield et al. 2021. Metagenomic sequencing and quantitative real-time PCR for fecal pollution assessment in an urban watershed. *Frontiers in Water*, 3:626849. <https://doi.org/10.3389/frwa.2021.626849>
- ◆ Fu, X., M.E. Hopton, X. Wang. 2021. Assessment of green infrastructure performance through the lens of urban resilience using fuzzy comprehensive evaluation. *Journal of Cleaner Production* 289(2):125146. <https://doi.org/10.1016/j.jclepro.2020.125146>
- ◆ Galella JG, S Kaushal, KL Wood, J Reimer, PM Mayer. 2021. Sensors track 'chemical cocktails' in streams impacted by road salts in the Chesapeake Bay watershed. Invited paper, *Environmental Research Letters* 16:035017. <https://iopscience.iop.org/article/10.1088/1748-9326/abe48f>
- ◆ Kaushal SS, G Likens, PM Mayer, M Pace, JE Reimer, CM Maas, JG Galella et al. Freshwater Salinization Syndrome: Past, Present, and Future Perspectives on a Global Issue. Invited paper, *Biogeochemistry*, in prep
- ◆ Jordan, PC, FA Hoover, and M.E. Hopton. (in review). Leveraging ancillary benefits from urban greenspace—a case study of St. Louis, Missouri. *Urban Water Journal*.

## SSWR.10.1.3

- ◆ United States Environmental Protection Agency (U.S. EPA). 2020a. WMOST Scenario Comparison with Benefits Module. EPA/600/B-20/242. (<https://www.epa.gov/ceam/wmost-scencompare-benefits-module>).
- ◆ United States Environmental Protection Agency (U.S. EPA). 2020b. Watershed Management Optimization Support Tool Benefits Module: Theoretical Documentation. EPA/600/R-20/244. ([Watershed Management Optimization Support Tool Benefits Module: Theoretical Documentation, Appendix A Illustrative calculations for cobenefits](#))
- ◆ US EPA. 2020. WMOST v3 Case Study: Cabin John Creek, Maryland. EPA/600/R-19/185.
- ◆ Piscopo, A., C. Weaver, and N. Detenbeck. (In external review) Using multi-objective optimization to inform green infrastructure decisions as part of robust integrated water resources management plans. Submitted to Journal of Water Resources Planning and Management. (partially supported by A\_E)
- ◆ Piscopo, A. GreenOpt <https://github.com/USEPA/Greenopt>, associated with Piscopo et al, above
- ◆ Detenbeck, N., R. Sullivan, and A. Piscopo. 2019. Watershed Management Optimization Support Tool (WMOST) v3.01 Training Webinar Series
- ◆ Detenbeck, N. 2019. Watershed Management Optimization Support Tool (WMOST) Fact Sheet EPA/600/F-18/054
- ◆ Detenbeck, N., A. Lee, A. Piscopo, T. Stagnitta, J. White, A. Brown, and M. ten Brink, 2018. User-Friendly Decision Support for Integrated Water Management: EPA's Watershed Management Optimization Support Tool. Proceedings, International Environmental Modeling and Software Society Conference, Fort Collins, CO, June 24-28, 2018. (Available online at: <https://scholarsarchive.byu.edu/cgi/viewcontent.cgi?article=3909&context=iemssconference> )



# Publications

## SSWR.10.1.3 cont.

- ◆ Stagnitta, T., N. Detenbeck, and A. Piscopo. 2018. Outlining the use of the U.S. EPA's Watershed Management Optimization Support Tool (WMOST): a case study in Taunton, Massachusetts. Proceedings, International Environmental Modeling and Software Society Conference, Fort Collins, CO, June 24-28, 2018. (Available online at: <https://scholarsarchive.byu.edu/iemssconference/2018/Stream-C/129/> )
- ◆ Piscopo, A., N. Detenbeck, and T. Stagnitta. 2018. Incorporating green infrastructure into water management plans using multi-objective optimization. Proceedings, International Environmental Modeling and Software Society Conference, Fort Collins, CO, June 24-28, 2018. (Available online at: <https://scholarsarchive.byu.edu/iemssconference/2018/Stream-C/130/> )
- ◆ Detenbeck, N., A. Piscopo, M. Tenbrink, C. Weaver, A. Morrison, T. Stagnitta, R. Abele, J. Leclair, T. Garrigan, V. Zoltay, A. Brown, A. Le, J. Stein, AND I. Morin. Watershed Management Optimization Support Tool v3. U.S. Environmental Protection Agency, Washington, DC, EPA/600/C-18/001, 2018. ([www.epa.gov/ceam/wmost](http://www.epa.gov/ceam/wmost) )
- ◆ Detenbeck, N., A. Piscopo, M. Tenbrink, C. Weaver, A. Morrison, T. Stagnitta, R. Abele, J. Leclair, T. Garrigan, V. Zoltay, A. Brown, A. Le, J. Stein, AND I. Morin. Watershed Management Optimization Support Tool (WMOST) v3: User Guide. US EPA Office of Research and Development, Washington, DC, EPA/600/R-17/255, 2018. ([www.epa.gov/ceam/wmost](http://www.epa.gov/ceam/wmost) )
- ◆ Detenbeck, N., M. Tenbrink, A. Piscopo, A. Morrison, T. Stagnitta, R. Abele, J. Leclair, T. Garrigan, V. Zoltay, A. Brown, A. Le, J. Stein, AND I. Morin. Watershed Management Optimization Support Tool (WMOST) v3: Theoretical Documentation. U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-17/220, 2018. ([www.epa.gov/ceam/wmost](http://www.epa.gov/ceam/wmost) )

## SSWR.10.2.3

- ◆ Beak, D., M. Borst, Steve Acree, R. Ross, Ken Forshay, R. Ford, J. Huang, C. Su, J. Brumley, A. Chau, AND C. Richardson. The Influence of Stormwater Management Practices and Wastewater Infiltration on Groundwater Quality: Case Studies. U.S. Environmental Protection Agency, Washington, DC, EPA/600/R-20/143, 2020.



**American Water Works  
Association**

*Dedicated to the World's Most Important Resource™*

Government Affairs Office  
1300 Eye Street NW  
Suite 701W  
Washington, DC 20005-3314  
T 202.628.8303  
F 202.628.2846

May 25, 2021

Joseph Rodricks, Chair  
Safe and Sustainable Water Resources BOSC Subcommittee  
c/o Tom Tracy  
Office of Science Policy  
Office of Research and Development (Mail Code 8104R)  
Environmental Protection Agency  
1200 Pennsylvania Ave. NW  
Washington, DC 20460-0001

**VIA ELECTRONIC DELIVERY**

RE: Board of Scientific Counselors, Safe and Sustainable Water Resources Subcommittee,  
Docket No. EPA-HQ-ORD-2015-0467

Dear Dr. Rodricks:

The American Water Works Associations appreciates the opportunity to comment to the Board of Scientific Counselors regarding the U.S. Environmental Protection Agency's Safe and Sustainable Water Resources National Research Program Strategic Research Action Plan, 2019 – 2022. The charge question made available to the public three business days before comments were due are not easy questions for the BOSC or the interested public to address:

1. "how these [drinking water] research activities can be comprehensively integrated to ensure safe disinfectant levels, while minimizing or eliminating exposure to lead, opportunistic pathogens, and DBPs in small treatment and distribution systems and in disadvantaged communities?"
2. "[what] recommendation(s) does the Subcommittee have regarding SSWR's water reuse research for helping to innovatively augment water supplies and improve resiliency by identifying promising alternative water sources?"
3. "[what] recommendation(s) does the Subcommittee have to improve the utility of these research activities to provide integrated decision-support tools for stormwater management in disadvantaged communities?"

Lead, Opportunistic Pathogens, and Disinfection Byproducts

Lead, *Legionella pneumophila*, and disinfection byproducts are all the topic of regulatory activity. There is recently completed revision of the Lead and Copper Rule (LCR).<sup>1</sup> Compliance with the corrosion control requirements of this rule are currently scheduled to be effective in 2024, and many states are already revising expectations of public water systems. It is not clear from the presentation if the budget and schedule for the activities listed will align with the LCR revision requirements and deadlines. EPA anticipates developing guidance to support LCR implementation. While the information being developed was not available in time to inform revision of the LCR, if it is available prior to the development of guidance it would be more influential. The structure of the LCR emphasizes prevention of corrosion control where there are lead service lines and sources of lead in plumbing. These conditions are associated with older housing and such housing tends to be more affordable and therefore home to disadvantaged households. Consequently, the timely availability of research that supports sound, practical, cost-effective corrosion control decision-making is an essential and timely need.

Recent research conducted by the Centers for Disease Control (CDC) is consistent with EPA's Safe Drinking Water Act program finding that opportunistic pathogens that proliferate in premise plumbing (e.g., *Legionella pneumophila* and *Mycobacterium avium*).<sup>2</sup> Disinfection byproducts (DBPs) are associated with drinking water disinfection used to control the risk posed by these and other pathogens in drinking water supplies. EPA has entered into an agreement to propose and promulgate revised drinking water standards for both *Legionella* and DBPs and anticipates proposing rule revisions in July 2024. This timeline is important because, a rulemaking is where the research program most clearly influences public policy and does so in a way that is consistent with executive orders for benefit-cost analysis, environmental justice, unfunded mandates, and impacts on small entities. As changes to disinfection requirements are and DBP controls are re-evaluated in the wake of changes to corrosion control requirements, the challenges associated with implementation will become increasingly challenging for community water systems, including those with limited technical, managerial, and financial capacity (e.g., including communities that serve lower income households). It is not clear from the presentation if the budget and schedule for the activities described by EPA will generate relevant work products that align with the Microbial/DBP (M/DBP) rulemaking process in time to inform rule development.

Previous M/DBP rule development processes have benefited from dedicated research and information development program that prioritized research objectives and the studies necessary to achieve those research objectives. These plans were developed in conjunction with stakeholders and supported substantial change in drinking water treatment and distribution system operations. A cohesive M/DBP research plan is critical to engaging the research community beyond EPA, as well as, timely delivery of EPA research deliverables.

---

<sup>1</sup> 86 Federal Register 4198, January 15, 2021.

<sup>2</sup> Collier, S. A., Deng, L., Adam, E. A., Benedict, K. M., Beshearse, E. M., Blackstock, A. J....Beach, M. J. (2021). Estimate of Burden and Direct Healthcare Cost of Infectious Waterborne Disease in the United States. *Emerging Infectious Diseases*, 27(1), 140-149. <https://doi.org/10.3201/eid2701.190676>.

### Providing Promising Alternative Water Sources

Additional federally supported research is needed to understand emerging risk associated with potable water as a function of our built environment, in particular (1) increased reliance on compromised / challenging water sources (e.g., seawater, saline aquifers, reuse of wastewater) and (2) impacts of building water systems on contaminants of health concern at points of exposure. As the nation transitions to reuse of water within structures, properties, or small collections of properties rather than through typical community-level treatment systems, a scientific basis is needed for adopting design standards, building codes, health codes, and state / federal regulatory frameworks that ensure sustainable, readily implemented and maintained risk management strategies. While there is a Water Reuse Action Plan and research is one element of that plan, it is not clear from the presentation if the budget and schedule for the activities described are aligned with a cohesive prioritize research plan or if adequate funds are being applied to priority needs.

### Reflecting on Prior AWWA Comments to the Sub-committee

A robust national research program is vital to the water sector and EPA's water research program is an essential part of that program. AWWA appreciates that EPA is engaging in a planning process to target available federal funds to meet the water sector's research needs.

AWWA commented to EPA in April of 2019 as the subcommittee was considering the current Safe and Sustainable Strategic Research Action Plan (StRAP). AWWA appreciates that some of those comments were incorporated into the final StRAP and now in the structure of the presentations made by EPA staff to the Committee:

1. **Align ORD research program with EPA program priorities.** There is a clearer tie than previously existed between the research activities described and the Safe Drinking Water Act program office activities
2. **Bring greater focus to ORD research program.** If the presentations offered to the Committee this week represent the greatest allocation of resources to support research, then it would appear that ORD is making a greater effort to focus the research program on a select set of priority needs.
3. **Be transparent as to what can be achieved with available funds.** While the SSWR StRAP continues to lack clear achievable objectives, the presentation of ongoing work prepared for the Committee suggests that the Agency, internally if not externally, is moving toward identifying accomplishable interim endpoints.
4. **Improve coordination across EPA research program.** In finalizing the current StRAP additional effort was taken to illustrate areas where multiple groups within ORD and across StRAPs are working on given topics in parallel (and presumably as a coordinated effort). There are clearly areas like disinfection byproducts and per- and polyfluoroalkyl substances where such coordination is essential. Even greater efforts are important to supporting programmatic efforts to achieve risk reduction.

There remain aspects of AWWA's prior comments that continue to require emphasis:

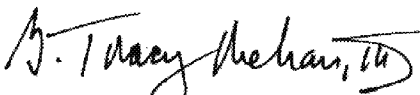
1. **Engage the water sector and water research funding community.** AWWA continues to offer to assist EPA engage the water sector to inform and execute its research agenda. While the staff presentations illustrate some engagement of a small number of selected external partners, the research planning process and research program remains insular. EPA should include contacting stakeholders, especially co-funding organizations, early in the StRAP development process so that we can provide input.
2. **Greater federal agency coordination on water research.** It is clear from ongoing cross-agency research planning that there is limited cross-fertilization or coordination among federal agencies with respect to drinking water research. Ongoing examples include the National Toxicology Program “Emerging Contaminants and Issues of Concern Program” and the National Institute of Environmental Health Sciences led “Drinking Water Contaminants of Emerging Concern for National Emerging Contaminant Research Initiative.” Summaries of implementation of the Water Reuse Action Plan are a timely illustration of how federal agency research coordination is often limited to relevant, concurrent work being reported out as a whole. But in practice, implementation is occurring without integration of multiple agencies research agendas.<sup>3</sup>

With the above examples available, AWWA is concerned that important research foci, like per- and polyfluoroalkyl substances are not being adequately coordinated. Unfortunately, neither EPA or other federal agencies maintain a publicly accessible resource for timely insight into individual agency or multi-agency research agendas. For the BOSC’s reference, available resources are primarily the EPA Science Inventory and EPA Research Grants Project Search. Other publicly accessible venues highlight particular outputs but not the elements or status of the research agenda.<sup>4,5</sup>

If you have any questions regarding these comments or if AWWA can be of assistance in some other way, please contact me or Steve Via at (202) 326-6130 or [svia@awwa.org](mailto:svia@awwa.org).

Best regards,

ON BEHALF OF THE AMERICAN WATER WORKS ASSOCIATION



G. Tracy Mehan, III

Executive Director – Government Affairs

---

<sup>3</sup> EPA. 2021. WRAP Action Activities and Highlights. Accessed May 25, 2021 at <https://www.epa.gov/waterreuse/wrap-action-activities-and-highlights>.

<sup>4</sup> EPA. 2021. EPA Science Inventory. Accessed May 25, 2021 at <https://cfpub.epa.gov/si/>.

<sup>5</sup> EPA. 2021. EPA Research Grants Project Search. Accessed May 25, 2021 at [https://cfpub.epa.gov/ncer\\_abstracts/index.cfm/](https://cfpub.epa.gov/ncer_abstracts/index.cfm/).

cc: Jennifer McLain, EPA/OW/OGWDW  
Andrew Sawyers, EPA/OW/OWM  
Debra Nagle, EPA/OW/OST

***Who is AWWA***

*The American Water Works Association (AWWA) is an international, nonprofit, scientific and educational society dedicated to providing total water solutions assuring the effective management of water. Founded in 1881, the Association is the largest organization of water supply professionals in the world. Our membership includes more than 4,000 utilities that supply roughly 80 percent of the nation's drinking water and treat almost half of the nation's wastewater. Our 50,000-plus total membership represents the full spectrum of the water community: public water and wastewater systems, environmental advocates, scientists, academicians, and others who hold a genuine interest in water, our most important resource. AWWA unites the diverse water community to advance public health, safety, the economy, and the environment.*

## Next Steps on Implementation of Executive Order 13985

March 8, 2021

### SCOPE OF DOCUMENT

This document, prepared by the Office of Management and Budget (OMB) in collaboration with the Domestic Policy Council (DPC), summarizes the near-term actions executive departments and agencies (agencies) should take to implement Executive Order 13985, on “Advancing Racial Equity and Support for Underserved Communities through the Federal Government,” including:

- (1) Initiating agency activities to complete an equity assessment of certain agency programs, policies, and processes, with a report due to the Assistant to the President for Domestic Policy by August 8, 2021;
- (2) Submitting a 90-day progress report to OMB by April 20, 2021, with an overview of initial progress and areas of focus for the agency’s 200-day equity assessment, following the progress-report template provided in Attachment B; and
- (3) Taking steps to respond to the revocation of EO 13950 on “Combating Race and Sex Stereotyping and implement of Section 10(b) of EO 13985, with a summary of agency actions to be submitted to OMB by March 22, 2021, following the summary template provided in Attachment A, pursuant to M-21-17.

### BACKGROUND

*“Because advancing equity requires a systematic approach to embedding fairness in decision-making processes, executive departments and agencies (agencies) must recognize and work to redress inequities in their policies and programs that serve as barriers to equal opportunity.”*

*-- Executive Order 13985, January 20, 2021*

On his first day in office, President Biden issued Executive Order (EO) 13985 outlining a whole-of-government approach to advancing an affirmative agenda of enhancing equity and access to truly equitable opportunity. As the EO describes, embedding equity in government decision making is now a mandate for the leadership and staff of every department and agency in the Executive Branch, with guidance and support from the White House, to deliver tangible changes that positively impact American lives. This charge is urgently needed in response to the converging economic, health, and climate crises of the moment that have exposed and exacerbated underlying inequities, and the historic movements highlighting the toll of systemic racism on our country.

Each area of focus directed in the EO demands determined, committed, and collaborative work within and among agencies, as well as components of the Executive Office of the President, to assess current and future policies, regulations, and actions, and to develop and implement processes and approaches to advance equity. An urgent near-term effort by agency and agency component leadership is required to identify and build out effective practices, tools, and strategies, as well as mid- and long-term efforts to apply those findings and develop new guidelines for policymaking, rulemaking, and program design. This effort must be designed to produce both immediate results that expand opportunity for Americans in underserved

communities, as well as to ensure that equity is ingrained in the Federal Government’s long-term decision-making processes across all of its many functions.

## KEY PRINCIPLES

Three key principles should ground agency activities pursuant to EO 13985:

- **Advancing equity must be a core part of management and policy making processes.** Achieving equity must go beyond delivering special projects or programs that focus on underserved communities. Equity must be a central component of the decision-making framework that all agency functions are routed through.
- **Successful equity work yields tangible changes that positively impact American lives.** Equity is not just a set of values, it must also be a set of tangible outcomes.
- **Equity benefits not just some of us, but all Americans.** If we close the gaps in income, wealth, and financial security for families across the country, our economy will grow. It is up to all of us as leaders to carry this message, and to demonstrate that advancing equity is not a zero-sum game that benefits some communities at the expense of others.

## AGENCY 200-DAY EQUITY ASSESSMENTS

Pursuant to Executive Order (EO) 13985, agencies shall conduct an equity assessment of certain high-priority, high-impact agency programs, policies, and processes, with a report due to the Assistant to the President for Domestic Policy by August 8, 2021. The scope of the 200-day agency equity assessments is described below. OMB will provide follow-on guidance to agencies regarding the format and submission process for agency equity assessment reports.

Many, if not all, aspects of agency practices, policies, programs, and actions can—and do—impact equity and outcomes for underserved communities. The 200-day agency equity assessments will serve as an initial starting point for agency efforts to learn about the equity impacts of agency programs, policies, and processes, and inform the first steps of a long-term agency action plan toward, as called for in the EO 13985, “a comprehensive approach to advancing equity for all.”

### General Scope of Equity Assessment

During the 200-day assessment period, each agency will work to capture initial findings along the following lines of inquiry about agency processes and functions to identify:

- Actionable opportunities to reduce administrative burden, remove barriers to enrollment, and improve equitable access for underserved communities to government **benefits and services**;
- Actionable opportunities to remove barriers to participation faced by underserved communities in **procurement** and **contracting** opportunities generally, and to focus on agency procurement or contracting opportunities that have an outsized impact on equity;
- The potential for equity-based guidelines to remove barriers for underserved communities to participation in Federal **grants** and other **financial assistance programs**, and specific

solicitations where there might be opportunity to address inequitable impact or proactively advance equity;

- Where there might be opportunity to address inequitable impact among current policies, regulations, and guidance, and actionable opportunities to develop **affirmative equity-enhancing policies, regulations, and guidance**, and approaches to centering equity in agency policy- and rule-making processes;
- Actionable opportunities to **improve data collection, use, and sharing** that would allow for disaggregation, the ability to deliver services more equitably, and better understanding of how programmatic and policy decisions impact on underserved communities;
- The sufficient use to date of **stakeholder engagement processes** to seek input on program and policy design and implementation from representatives of members of communities that have been historically underserved by, or subject to discrimination in, agency policies and programs, as well as community-based organizations and civil rights organizations, and an assessment of the most effective mechanisms used by the agency for engagement; and
- The operational status of, and level of resources available to, **offices or divisions within the agency that are responsible for advancing civil rights** or whose mandates specifically include serving underrepresented or disadvantaged communities (of note, equity must be a central consideration of the decision-making frameworks that all agency functions are routed through).

Through the course of this initial assessment, agencies are expected to begin, in coordination with OMB as appropriate, implementation of proactive steps to advance equity and support for underserved communities, on an iterative basis, informed by stakeholder engagement, consistent with applicable law, and subject to the availability of appropriations. The EO is designed to ensure that agencies move expeditiously towards tangible outcomes that increase investment of federal resources in underserved communities and building mechanisms to ensure equity is part of all agency decision-making processes on an ongoing basis.

#### Targeted Focus on Several Programs and Policies

As part of the 200-day equity assessment, each agency shall, in consultation with the Office of Management and Budget (OMB), select several high-priority, high-impact programs and policies for intensive review and assessment, during this 200-day equity assessment period, based on the agency's initial hypotheses of the potential opportunity for advancing equitable outcomes through a focused assessment effort of such programs and policies. Programs selected should include at least one that is not typically thought of as benefitting underserved communities, to assess whether past practices have overlooked possibilities for more equitable strategies.

#### **PROGRESS REPORT DUE BY APRIL 20, 2021**

To inform agency consultation with OMB and DPC ahead of submission of agency 200-day equity assessment reports, OMB requests that agencies submit a 90-day progress report to OMB by April 20, 2021, with an overview of initial progress and areas of focus for the agency's 200-day equity assessment, following the progress-report template provided in Attachment B.

Agencies will submit their up-to-15-page progress reports to the OMB via a MAX site, link to be provided prior to the report due date.

The 24 Chief Financial Officers (CFO) Act agencies can anticipate that their Agency Equity Team will be invited to participate in an initial consultation meeting with a cross-functional OMB team, prior to submission of their 90-day progress reports. An additional consultation meeting with OMB will follow submission of agency progress reports, and iterative interactions with OMB and DPC, and other EOP components as appropriate, will take place throughout the course of equity assessments and follow-on agency action planning.

All agencies can reach out to [equity@omb.eop.gov](mailto:equity@omb.eop.gov), as well as their OMB Examiner and Resource Management Office, with questions and support needs.

If agencies have additional questions on OMB MAX access, or on the development of the 90-day Progress Report or 200-day Equity Assessment, please direct questions to OMB and DPC at [equity@omb.eop.gov](mailto:equity@omb.eop.gov).

## **SUMMARY OF AGENCY ACTIONS PURSUANT TO REVOKED EO 13950**

Agencies should report to OMB by March 22, 2021 on steps taken pursuant to Section 10(b) of EO 13985, to review and identify proposed and existing agency actions related to or arising from EO 13950, which was revoked by EO 13985. By March 22, 2021, agencies should have considered suspending, revising, or rescinding any such actions, including all agency actions to terminate or restrict contracts or grants pursuant to EO 13950, as appropriate and consistent with applicable law. Agencies can find additional guidance related to implementation of Section 10(b) of EO 13985 in OMB memorandum [M-21-17](#), issued on March 2, 2021. A template for summaries of agency actions pursuant to M-21-17 is provided in Attachment A, and these up-to-3-page reports should be submitted to OMB via MAX, link to be provided.

## **ESTABLISHMENT OF AGENCY EQUITY TEAMS**

### Purpose of Agency Equity Teams

The establishment of Agency Equity Teams will facilitate, inform, and advance agency progress on the equity assessments, action planning, and other agency actions directed by EO 13985. Agency Equity Teams should meet regularly on the implementation of EO 13985, including to inform, drive, and participate in stakeholder consultation with members of communities who have been historically underrepresented in the Federal Government and underserved by, or subject to discrimination in, Federal policies and programs. In addition, members of Agency Equity Teams will support progress reporting and consultation between agencies and the Executive Office of the President on agency equity-assessment efforts, participate in interagency policy committees and an interagency learning community on equity, and inform OMB's study of equity assessment tools.

The Agency Equity Teams should serve as leaders of work that is occurring enterprise-wide within and across your agencies, not siloed within one office or these internal teams.

### Leadership Representation in Diverse and Empowered Agency Equity Teams

DPC and OMB anticipate that Agency Equity Team membership will vary among agencies based on each agency's unique mission, structure, and organization, and that Agency Equity Team membership may evolve over time as agencies progress in their equity assessment and planning. Agencies should, in general, ensure representation from the following offices and functions in Agency Equity Teams, where appropriate:

- Agency head's front office
- Regulatory affairs senior designee
- Counsel
- Civil rights enforcement senior designee
- Policy development senior designee
- Chief Financial Officer, Controller, or senior designee
- Chief Data Officer or senior designee
- Chief Science Officer or senior designee
- Chief Human Capital Officer or senior designee
- Performance Improvement Officer, or senior designee
- Evaluation Officer or senior designee
- Statistical official
- Procurement senior designee
- Customer/user experience leadership
- Communications/public affairs senior designee
- Public engagement senior designee

Agency Equity Teams also should either include representation from agency operating divisions and components or otherwise regularly meet, communicate, and coordinate with leadership of such divisions and components, as well as with operating division/component counterparts of the offices and functions listed above. We also encourage agencies to strive for meaningful diversity, keeping in mind the underrepresented communities these EO seeks to address, and the need to engage a range of viewpoints and skills in the selection of these teams. Agency Equity Teams should ensure their decision-making processes include input from agency employees at all levels of the agency and are informed by stakeholder consultation processes as described above and required by EO 13985.

Finally, looking ahead to the 1-year planning process, agencies should consider not only outreach and engagement initiatives, but how to involve the very communities and populations this effort is meant to serve in agency equity assessment and planning processes in the future, looking to examples from cities and organizations that have included underserved community representatives *as part of* equity assessment teams. Through the interagency learning community, OMB will support exchange among agencies of examples and promising practices for external partnership.

## Notification to OMB of Agency Equity Team Members

Agencies should have already established initial membership of Agency Equity Teams. To facilitate engagement of your Agency Equity Teams into interagency policy committees and an interagency learning community on equity, agencies were asked to transmit to [equity@omb.eop.gov](mailto:equity@omb.eop.gov) the names, titles, and contact information for Agency Equity Team primary points of contact to the Executive Office of the President (ideally, 1-3 people), as well as the names, titles, and contact information for other initial Agency Equity Team members. If you have not already done so, please send this information as soon as possible.

## **EQUITY ASSESSMENT TOOLS AND APPROACHES**

OMB will facilitate an interagency learning community that provides a consistent and centralized resource to share what agencies are learning through their assessment work, and allow agencies to elevate barriers, common needs, effective practices, etc. Through this process, OMB will connect agencies to the right points of contact across OMB and the Executive Office of the President for consultation and problem-solving on issues that arise.

During the course of the 200-day agency equity assessments, OMB will also hold weekly office hours with designated agency equity assessment points of contact to gather common agency questions and agency hypotheses under consideration.

OMB will organize a series of listening sessions with practitioners in state and local government, philanthropy, and racial equity and civil society organizations. OMB will share learnings from these listening sessions with agencies to raise awareness among Agency Equity Teams about effective practices for equity assessments, project planning, and other relevant topics that would be helpful in advancing this work.

## **EQUITY AND AGENCY PERFORMANCE MANAGEMENT**

In the development of their Agency Strategic Plans, Agency heads and Chief Operating Officers, supported by Performance Improvement Officers, shall align their strategic goals and objectives, including Agency Priority Goals, as appropriate, with the Administration's priorities, and in particular to advance equity pursuant to EO 13985. Agencies are encouraged to proactively form partnerships in areas where programs from multiple agencies must work together to achieve a common outcome to advance equity. Agency draft strategic plan objectives and priority goals are due to OMB on June 4. OMB will work to integrate goals and efforts to advance equity pursuant to EO 13985 into the President's Management Agenda, and will subsequently determine Cross Agency Policy Goals that advance equity, also pursuant to EO 13985.

## **DEFINITIONS**

EO 13985 offers two definitions to inform agency and interagency efforts to implement the executive order, including:

**Equity**: the consistent and systematic fair, just, and impartial treatment of all individuals, including individuals who belong to underserved communities that have been denied such treatment, such as Black, Latino, and Indigenous and Native American persons, Asian Americans and Pacific Islanders and other persons of color; members of religious minorities; lesbian, gay, bisexual, transgender, and queer (LGBTQ+) persons; persons with disabilities; persons who live in rural areas; and persons otherwise adversely affected by persistent poverty or inequality. (While not mentioned in the Executive Order explicitly, agencies may also look to additional underserved communities, such as immigrants or first-generation college students.)

**Underserved communities**: populations sharing a particular characteristic, as well as geographic communities, that have been systematically denied a full opportunity to participate in aspects of economic, social, and civic life, as exemplified by the list in the preceding definition of “equity.”

**Attachments:**

Attachment A:	Template for Reports on Agency Actions Pursuant to M-21-17 and Section 10(b) of Executive Order 13985
Attachment B:	Template for 90-Day Agency Progress Reports

# OSAPE Extramural Grants Program



Mary Ross, Director  
Office of Science Advisor, Policy and Engagement



# OSAPE Mission

- Engage with ORD, EPA, and external partners to advance, evaluate, and communicate science that informs impactful decisions to protect public health and the environment today and tomorrow.

The mission of EPA is to protect human health and the environment

The mission of ORD is to provide the best available environmental science and technology to inform and support public health and environmental decision-making at the federal, state, tribal and local levels

The mission of OSAPE is to engage with ORD, EPA, and external partners to advance, evaluate, and communicate science that informs impactful decisions to protect public health and the environment today and tomorrow



## OSAPE Programs

### **Provide a scientific foundation for EPA and ORD**

- Scientific Integrity
- Science and Technology Policy Council
- Human Subjects Research Protection
- Innovation: Citizen Science, Challenges
- Scientific Support for Decision Making

### **Advance scientific discovery by funding the external scientific community and leading innovation programs**

- Extramural research programs
- Small Business Innovation Research
- People, Prosperity and the Planet (P3)
- Challenges and Prizes

### **Engage Regions, Tribes, communities, and other partners to enhance ORD research.**

- Regional Science Program
- Tribal Science Council
- ORD EJ Council
- Translation



# OSAPE Extramural Research Programs and Competitions

## Extramural Research

- Science to Achieve Results (STAR)
- National Priorities
- Water Technology
- People, Prosperity and the Planet (P3)
- Small Business Innovation Program (SBIR)



## Challenges and Internal Competitions

- Challenges and Prizes program
- Pathfinder Innovation Projects (PIPs)
- Regional/State/Tribal Innovation Projects (RSTIP)
- Regional Applied Research Effort (RARE)





# Current SSWR Water Treatment and Infrastructure Grants

(Short) RFA Title	Broad Goal	Project End Date
<b>NP PFAS in Rural Communities</b>	Better understand the potential impacts of PFAS on water quality and availability in rural communities and agricultural operations	Aug 2023
<b>STAR PFAS in GW and Landfills</b>	Better understand the environmental risks and manage impacts of PFAS in groundwater and landfills	Aug 2022
<b>NP PFAS</b>	Investigate the fate and transport characteristics and behavior, exposure profiles, and toxicological effects of PFAS	April 2022
<b>NP Lead</b>	Create a consumer-centric framework to detect and control lead in drinking	April 2023
<b>NP Premise Plumbing</b>	Research water quality issues related to low flow conditions of drinking water in premise plumbing systems	Sep 2021
<b>STAR Infrastructure Modeling Center</b>	Outreach, research, and code development for EPA SWMM, EPANET, and other software	August 2023



## Upcoming SSWR Awards & RFAs

TOPIC	Status	PROGRAM
Evaluation of Pollutants in Biosolids	Grant Awards July 2021	National Priorities
Viral Pathogen and Surrogate Approaches for Assessing Treatment Performance in Water Reuse	Grant Awards July 2021	STAR
Deployment of Innovative Water Technologies for Very Small Drinking Water Systems	Grant Award July 2021	Water Technology
Water Quality Benefits	RFA opening Summer 2021	STAR
Life-Cycle Analysis to Support Cost-Effective Enhanced Aquifer Recharge	RFA opening Summer 2021	STAR
Water Innovation, Science and Engagement to Advance Water Reuse	RFA opening Summer 2021	National Priorities
Innovative Approaches for Detection and Public Health Surveillance of Coronaviruses and Other Pathogens in Wastewater	RFA opening Summer 2021	National Priorities
Innovative Water Technologies: Lagoon Wastewater Systems in Small Communities	RFA opening Fall 2021	Water technology



## RFA Topic Development

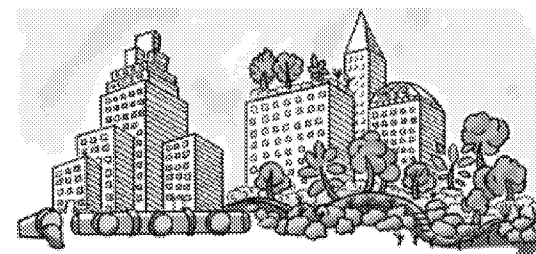
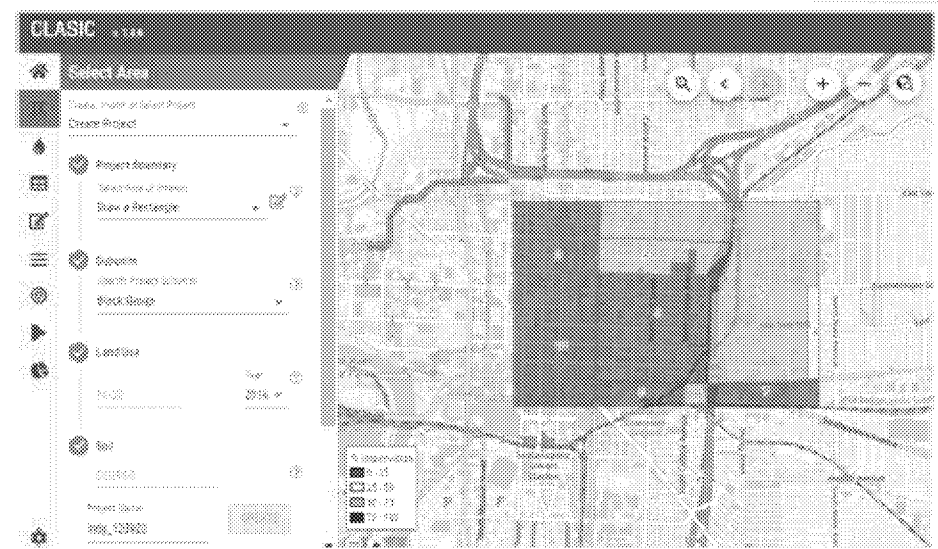
- **FY 22 RFA topics selected by June 2021**
  - Hold topic development meeting in June with Regional and Program Office Stakeholders to obtain input on potential research topics for the STAR, National Priorities and Water Technology grant programs
  - FY 22 RFA Writing Teams to start this summer
- **Future RFA topics (FY 23 & 24) to be discussed at upcoming StRAP planning meetings to inform future RFA priorities.**
  - Goal: Strategically integrate intramural and extramural research efforts to create a robust portfolio



# National Priorities Life Cycle Costs

**Water Research Foundation developed the Community-enable Lifecycle Analysis of Stormwater Infrastructure Costs (CLASIC) screening tool**

- Utilizes a lifecycle cost framework to support green and grey stormwater infrastructure decisions.
- Currently available and free to the public.
- <https://www.epa.gov/water-research/green-infrastructure-modeling-toolkit>



## CLASIC



## Questions

Mary Ross, PhD

Director, Office of Science Advisor, Policy and Engagement

Office of Research and Development

Washington DC 20460

202-564-8379



Main webpage for research grants: <https://www.epa.gov/research-grants>

## Appointment

---

**From:** Tracy, Tom [Tracy.Tom@epa.gov]  
**Sent:** 4/27/2021 6:24:51 PM  
**To:** Tracy, Tom [Tracy.Tom@epa.gov]; Scott Ahlstrom [Scott.Ahlstrom@CorixTexas.com]; ahlmail [Ex. 6]; Jerad Bales [jdbales@cuahsi.org]; blanz@adeq.state.ar.us; ewb100@psu.edu; Carr, Steve [scarr@lacsds.org]; sfc9582 [Ex. 6]; cole.david@deq.state.or.us; jb\_dooan [Ex. 6]; Timothy Davis [timdavi@bgsu.edu]; jducoste@ncsu.edu; Elizabeth Fassman-Beck [elizabethfb@sccwrp.org]; Hitzhusen, Fred [Hitzhusen.1@osu.edu]; Kate Lajtha [Kate.lajtha@oregonstate.edu]; miclorah [Ex. 6]; mmlorah@usgs.gov; John Lowenthal [John.lowenthal@cardno-gs.com]; eastmeetswest [Ex. 6]; Joseph V Rodricks [JRodricks@ramboll.com]; Tim Verslycke [tverslycke@gradientcorp.com]; stevew@sccwrp.org; John R White [jrwhite@lsu.edu]; ljohnson@d.umn.edu; VanDrunick, Suzanne [vanDrunick.Suzanne@epa.gov]; Williams, Joe [Williams.Joe@epa.gov]; Pollard, Amina [Pollard.Amina@epa.gov]  
**CC:** Amy.scheuer@icf.com; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [OFarrell.Thomas@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Ross, Mary [Ross.Mary@epa.gov]; Impellitteri, Christopher [Impellitteri.Christopher@epa.gov]; Lytle, Darren [Lytle.Darren@epa.gov]; Villegas, Eric [Villegas.Eric@epa.gov]; Simmons, Jane [Simmons.Jane@epa.gov]; Murray, Regan [Murray.Regan@epa.gov]; Garland, Jay [Garland.Jay@epa.gov]; Hopton, Matthew [Hopton.Matthew@epa.gov]; Patterson, Craig [Patterson.Craig@epa.gov]; Thurston, Hale [Thurston.Hale@epa.gov]; Grimm, Ann [Grimm.Ann@epa.gov]; Johnston, JohnM [Johnston.JohnM@epa.gov]; robert.edelman@vdh.virginia.gov; Burns, Robert [Burns.Robert@epa.gov]; Orme-Zavaleta, Jennifer [Orme-Zavaleta.Jennifer@epa.gov]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Blackburn, Elizabeth [Blackburn.Elizabeth@epa.gov]; Lan, Alexis [lan.alexis@epa.gov]; Bryant, Alexis [bryant.alexis@epa.gov]; Musson, Steve [Musson.Steve@epa.gov]; Sayles, Gregory [Sayles.Gregory@epa.gov]; Thomas, Russell [Thomas.Russell@epa.gov]; Watkins, Tim [Watkins.Tim@epa.gov]; Strong, Jamie [Strong.Jamie@epa.gov]; Packard, Benjamin [Packard.Benjamin@epa.gov]; Latham, Michelle [Latham.Michelle@epa.gov]; Boone, Hannah [Boone.Hannah@epa.gov]; Rashleigh, Brenda [Rashleigh.Brenda@epa.gov]; Russell, Marc [Russell.Marc@epa.gov]; Ohanian, Edward [Ohanian.Edward@epa.gov]; Braverman, Carole [braverman.carole@epa.gov]; Morton, Michael [Morton.Michael@epa.gov]; Roberts, Cindy [Roberts.Cindy@epa.gov]; O'Mara, Kate [OMara.Kate@epa.gov]; COLE David \* DEQ [david.cole@deq.state.or.us]; ORD-OSAPE-RSL [ORD-OSAPE-RSL@epa.gov]; Pensak, Mindy [Pensak.Mindy@epa.gov]; Smith, Bernice [Smith.Bernice@epa.gov]; Chaudhry, Rabia [Chaudhry.Rabia@epa.gov]; Mattingly, Justin [Mattingly.Justin@epa.gov]; Nappier, Sharon [Nappier.Sharon@epa.gov]; OST-HECD-HRAB [OST-HECD-HRAB@epa.gov]; Ravenscroft, John [Ravenscroft.John@epa.gov]; Zahreddine, Phil [Zahreddine.Phil@epa.gov]; Elleman, Robert [Elleman.Robert@epa.gov]; Taylor, Dawn [Taylor.Dawn@epa.gov]; Basile, Alfred [Basile.Alfred@epa.gov]; Geroux, Nicholas [Geroux.Nicholas@epa.gov]; Best-Wong, Benita [Best-Wong.Benita@epa.gov]; Nagle, Deborah [Nagle.Deborah@epa.gov]; Miller, Wynne [Miller.Wynne@epa.gov]; Guilaran, Yu-Ting [Guilaran.Yu-Ting@epa.gov]; ORD-IOAA-PANPD [ORDIOAAPANPD@epa.gov]; ORD-IOAA-NPD [ORDIOAANPD@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Taylor, Christopher [Taylor.Christopher@epa.gov]; Shatas, Angie [Shatas.Angie@epa.gov]; Small, Matthew [Small.Matthew@epa.gov]; Jones, Samantha [Jones.Samantha@epa.gov]; Ryan, Shawn [Ryan.Shawn@epa.gov]; Owens, Beth [Owens.Beth@epa.gov]; Tietge, Joe [Tietge.Joe@epa.gov]; Chamberlain, Eliodora [Chamberlain.Eliodora@epa.gov]; Donohue, Joyce [Donohue.Joyce@epa.gov]; Cunningham, Kelly [cunningham.kelly@epa.gov]; Keel, Adrienne [keel.adrienne@epa.gov]; Hall, Lynda [Hall.Lynda@epa.gov]; Goo, Robert [Goo.Robert@epa.gov]; Wall, Tom [Wall.Tom@epa.gov]; Yusuf, Istanbul [Yusuf.Istanbul@epa.gov]; Connors, Sandra [Connors.Sandra@epa.gov]; Rodgers-Jenkins, Crystal [Rodgers-Jenkins.Crystal@epa.gov]; Wang, Lili [Wang.Lili@epa.gov]; Hautman, Dan [Hautman.Dan@epa.gov]; Janke, Robert [Janke.Robert@epa.gov]; Varughese, Eunice [Varughese.Eunice@epa.gov]; Jacobs, Brittany [jacobs.brittany@epa.gov]; Bergdale, Amy [Bergdale.Amy@epa.gov]  
**Subject:** BOSC SSWR Virtual Meeting  
**Attachments:** Untitled Attachment; Untitled Attachment; 2021\_BOSC\_SSWR\_VPG\_Registrants.pdf; 2021\_BOSC\_SSWR\_VPG\_Members and Presenters.pdf; SSWR\_BOSC\_Water Treatment Infrastructure \_Agenda+Charge Questions\_May 26-27 2021.pdf; Zoom for Government Guide.docx; SSWR BOSC CPHEA Intro WTI capabilities 052421 final.pdf; BoSC\_WTI\_Charge Question PPT\_5-26-21\_van Drunick.pdf; BoSC\_WTI\_CCTE Overview\_5\_26\_2021.pdf; BoSC\_WTI\_CEMM Overview\_5-27-21.pdf; BoSC\_WTI\_RA7\_Drinking Water\_5-26-21.pdf; BoSC\_WTI\_RA11\_Tech Support\_5-26-21.pdf; BoSC\_WTI\_RA9\_Wastewater+Water Reuse\_5-27-21.pdf; BoSC\_WTI\_RA10\_Stormwater\_5-27-21.pdf; 2021 05 25 AWWA Comments to BOSC Safe and Sustainable Sub Com.pdf; 2021-3-8 Equity\_EO\_Initial Implementation.pdf; SSWR WTI BoSC - OSAPE v2.pdf

**Location:** Zoom - Connection Info Below

**Start:** 5/26/2021 4:00:00 PM

**End:** 5/26/2021 9:00:00 PM

**Show Time As:** Busy

**Recurrence:** Daily  
every day from 12:00 PM to 5:00 PM

**Required Attendees:** Scott.Ahlstrom@CorixTexas.com; ahlmail[Ex. 6]; Jerad Bales; blanz@adeq.state.ar.us; ewb100@psu.edu; scarr@lacs.org; sfc95823[Ex. 6]; cole.david@deq.state.or.us; jb\_doohan[Ex. 6]; Timothy Davis; jducoste@ncsu.edu; Elizabeth Fassman-Beck; Hitzhusen.1@osu.edu; kate.lajtha@oregonstate.edu; miclorah[Ex. 6]; mmlorah@usgs.gov; john.lowenthal@cardno-gs.com; eastmeetswest1[Ex. 6]; Joseph V Rodricks; tverslycke@gradientcorp.com; steview@sccwrp.org; jrwhite@lsu.edu; ljohnson@d.umn.edu; VanDrunick, Suzanne; Williams, Joe; Pollard, Amina

**Optional Attendees:** Scheuer, Amy; Trentacoste, Emily; O'Farrell, Thomas; Penalva-Arana, Carolina; Doa, Maria; Ross, Mary; Impellitteri, Christopher; Lytle, Darren; Villegas, Eric; Simmons, Jane; Murray, Regan; Garland, Jay; Hopton, Matthew; Patterson, Craig; Thurston, Hale; Grimm, Ann; Johnston, JohnM; Robert.Edelman@vdh.virginia.gov; Burns, Robert; Orme-Zavaleta, Jennifer; Frey, Christopher; Rodan, Bruce; Blackburn, Elizabeth; Lan, Alexis; Bryant, Alexis; Musson, Steve; Sayles, Gregory; Thomas, Russell; Watkins, Tim; Strong, Jamie; Packard, Benjamin; Michelle Latham; Boone, Hannah; Rashleigh, Brenda; Russell, Marc; Ohanian, Edward; Braverman, Carole; Morton, Michael; Roberts, Cindy; O'Mara, Kate; COLE David \* DEQ; ORD-OSAPE-RSL; Pensak, Mindy; Smith, Bernice; Chaudhry, Rabia; Mattingly, Justin; Nappier, Sharon; OST-HECD-HRAB; Ravenscroft, John; Zahreddine, Phil; Elleman, Robert; Taylor, Dawn; Basile, Alfred; Geroux, Nicholas; Best-Wong, Benita; Nagle, Deborah; Miller, Wynne; Guilaran, Yu-Ting; ORD-IOAA-PANPD; ORD-IOAA-NPD; Hunt, Sherri; Taylor, Christopher; Shatas, Angie; Small, Matthew; Jones, Samantha; Ryan, Shawn; Owens, Beth; Tietge, Joe; Chamberlain, Eliodora; Donohue, Joyce; Cunningham, Kelly; Keel, Adrienne; Hall, Lynda; Goo, Robert; Wall, Tom; Yusuf, Istanbul; Connors, Sandra; Rodgers-Jenkins, Crystal; Wang, Lili; Hautman, Dan; Janke, Robert; Varughese, Eunice; Jacobs, Brittany; Bergdale, Amy

Join Zoom Meeting: [Ex. 6]

Meeting ID: [Ex. 6]

Passcode: [Ex. 6]

## Appointment

---

**From:** Tracy, Tom [Tracy.Tom@epa.gov]  
**Sent:** 4/29/2021 4:31:37 PM  
**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [sandysmithaust@Ex. 6]; Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [croes.bart@Ex. 6]; jennifer hains [hainsjc@Ex. 6]; Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Irivers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu  
**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [artwerner01@Ex. 6]; Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Orme-Zavaleta, Jennifer [Orme-Zavaleta.Jennifer@epa.gov]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]  
**Subject:** BOSC AE Subcommittee Mtg  
**Attachments:** Untitled Attachment; Untitled Attachment; Untitled Attachment  
**Location:** Connection Information Coming Soon  
  
**Start:** 10/12/2021 3:00:00 PM  
**End:** 10/12/2021 9:00:00 PM  
**Show Time As:** Busy  
  
**Recurrence:** Daily  
every day from 11:00 AM to 5:00 PM  
**Required Attendees:** ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01@Ex. 6'; Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman,Paul ; ljohnson@d.umn.edu  
**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner01@Ex. 6; Hains, Jennifer (MDH); Orme-Zavaleta, Jennifer; Frey, Christopher; Rodan, Bruce; Lass, Taylor

-----Original Appointment-----

**From:** Tracy, Tom <Tracy.Tom@epa.gov>

**Sent:** Friday, April 9, 2021 1:02 PM

**To:** Tracy, Tom; ca.geffen@pnnl.gov; Sandy Smith; Viney P Aneja; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; jennifer hains; Keslar, Cara; mtkleinm@uci.edu; Myron Mitchell; Irivers@ncsu.edu; Rohr, Annette; Constance Senior; Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; canden.byrd@icf.com; Scheuer, Amy; Paul Gilman; ljohnson@d.umn.edu

**Cc:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; Art Werner; Hains, Jennifer (MDH)

**Subject:** BOSC AE Subcommittee Mtg

**When:** Occurs every day effective 10/12/2021 until 10/14/2021 from 11:00 AM to 5:00 PM (UTC-05:00) Eastern Time (US & Canada).

**Where:** Connection Information Coming Soon

## Appointment

---

**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [sandysmithaust@Ex. 6] Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [croes.bart@Ex. 6]; jennifer hains [hainsjc@Ex. 6] Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Irivers@ncsu.edu; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; Rohr, Annette [ARohr@epri.com]; ljohnson@d.umn.edu

**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [artwerner01@Ex. 6] Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Orme-Zavaleta, Jennifer [Orme-Zavaleta.Jennifer@epa.gov]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]

**Start:** 10/12/2021 3:00:00 PM

**End:** 10/12/2021 9:00:00 PM

**Recurrence:** (none)

## Appointment

---

**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [sandysmithaustx@Ex. 6] Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [croes.bart@Ex. 6] jennifer hains [hainsj@Ex. 6]; Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Irivers@ncsu.edu; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; Rohr, Annette [ARohr@epri.com]; ljohnson@d.umn.edu

**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [artwerner01@Ex. 6] Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Orme-Zavaleta, Jennifer [Orme-Zavaleta.Jennifer@epa.gov]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]

**Start:** 10/13/2021 3:00:00 PM

**End:** 10/13/2021 9:00:00 PM

**Recurrence:** (none)

## Appointment

---

**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [sandysmithaustx[REDACTED] Ex. 6] Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [croes.bart[REDACTED] Ex. 6] jennifer hains [hainsjc[REDACTED] Ex. 6] Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Irivers@ncsu.edu; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; Rohr, Annette [ARohr@epri.com]; ljohnson@d.umn.edu

**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [artwerner01[REDACTED] Ex. 6] Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Orme-Zavaleta, Jennifer [Orme-Zavaleta.Jennifer@epa.gov]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]

**Start:** 10/14/2021 3:00:00 PM

**End:** 10/14/2021 9:00:00 PM

**Recurrence:** (none)

## Appointment

---

**From:** Tracy, Tom [Tracy.Tom@epa.gov]  
**Sent:** 4/29/2021 4:31:37 PM  
**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [sandysmithaust@Ex. 6]; Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [croes.bart@Ex. 6]; jennifer hains [Ex. 6]; Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; lrivers@ncsu.edu; Rohr, Annette [arohr@epri.com]; Constance Senior [connie@conniesenior.com]; 'artwerner01@Ex. 6'; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com; Amy.scheuer@icf.com; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu  
**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6]; Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]  
**Subject:** BOSC AE Subcommittee Mtg  
**Attachments:** Untitled Attachment; Untitled Attachment; Untitled Attachment; Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Agenda FINAL\_v2.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; AE Deliverables Table for BOSC 2021.pdf  
**Location:** ZOOM - Connection Info Below  
**Start:** 10/12/2021 3:00:00 PM  
**End:** 10/12/2021 10:00:00 PM  
**Show Time As:** Tentative  
**Recurrence:** Daily  
every day from 11:00 AM to 6:00 PM  
**Required Attendees:** ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01@Ex. 6'; Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman,Paul ; ljohnson@d.umn.edu  
**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner01@Ex. 6; Hains, Jennifer (MDH); Frey, Christopher; Rodan, Bruce; Lass, Taylor

Ex. 6

Meeting ID: Ex. 6

Passcode: Ex. 6

## Tools and Resources developed by ORD to understand impacts of the changing climate and inform adaptation

(Information relevant to CQ2 and CQ3)

Resource Name	Link
Global Change Explorer	<a href="https://www.epa.gov/gcx">https://www.epa.gov/gcx</a>
Multisector Evaluation Tool for identifying Resilience Opportunities (METRO)	<a href="https://metro.epa.gov/About.aspx">https://metro.epa.gov/About.aspx</a> <a href="https://cfpub.epa.gov/ncea/global/recorddisplay.cfm?deid=322482">https://cfpub.epa.gov/ncea/global/recorddisplay.cfm?deid=322482</a>
Integrated Climate and Land Use Scenarios (ICLUS)	<a href="https://iclus.epa.gov/#v=map&amp;b=gray-vector&amp;l=3!8!9!6&amp;x=-97.32566406249403!-77.03!-75.55!-122.4&amp;y=37.61672114390015!38.7!40.43!37.78&amp;m=1&amp;s=ssp2!ssp2!ssp2!ssp2&amp;d=land_use!land_use!land_use!land_use&amp;o=giss_e2_rl!giss_e2_rl!giss_e2_rl!giss_e2_rl&amp;a=0&amp;z=2">https://iclus.epa.gov/#v=map&amp;b=gray-vector&amp;l=3!8!9!6&amp;x=-97.32566406249403!-77.03!-75.55!-122.4&amp;y=37.61672114390015!38.7!40.43!37.78&amp;m=1&amp;s=ssp2!ssp2!ssp2!ssp2&amp;d=land_use!land_use!land_use!land_use&amp;o=giss_e2_rl!giss_e2_rl!giss_e2_rl!giss_e2_rl&amp;a=0&amp;z=2</a>
Critical Loads Mapper (CL Mapper)	<a href="https://clmapper.epa.gov/">https://clmapper.epa.gov/</a>
GCX-LASSO (Locating and Selecting Scenarios Online)	<a href="https://lasso.epa.gov/">https://lasso.epa.gov/</a>
Adaptation Design Tool (ADT)*	<a href="https://www.epa.gov/gcx/about-adaption-design-tool-adt">https://www.epa.gov/gcx/about-adaption-design-tool-adt</a> <a href="https://www.coris.noaa.gov/activities/CCAP_design/">https://www.coris.noaa.gov/activities/CCAP_design/</a>
ADT online course	<a href="https://reefresilience.org/community-based-climate-adaptation/climate-adaptation-tools/ccap-adaptation-design-tool/">https://reefresilience.org/community-based-climate-adaptation/climate-adaptation-tools/ccap-adaptation-design-tool/</a>
Coastal Resilience Tool	<a href="https://maps.coastalresilience.org/">https://maps.coastalresilience.org/</a>
The 20 Watersheds tool	<a href="https://20watersheds.epa.gov/20watersheds/">https://20watersheds.epa.gov/20watersheds/</a>
Sea-Level Affecting Marshes Model (SLAMM)	<a href="https://www.epa.gov/gcx/about-delaware-bay-wetland-projections">https://www.epa.gov/gcx/about-delaware-bay-wetland-projections</a>
GLIMPSE	<a href="https://www.epa.gov/air-research/glimpse-computational-framework-supporting-state-level-environmental-and-energy">https://www.epa.gov/air-research/glimpse-computational-framework-supporting-state-level-environmental-and-energy</a>
TIMES 9-Region Energy Systems Database	<a href="https://www.epa.gov/air-research/epaus9rt-energy-systems-database-use-times-model">https://www.epa.gov/air-research/epaus9rt-energy-systems-database-use-times-model</a>

## CQ1: Science Needs Related to Air Toxic Sources and Emerging Contaminants

The following table lists anticipated Air, Climate, and Energy (ACE) deliverables relevant to Charge Question 1. The Outputs and Products may change as new scientific findings emerge. Completion of Outputs and Products is contingent on appropriate resources being available. ACE will continue to actively engage with EPA Partners to meet their needs and inform the reviews of the NAAQS and implementation strategies.

ID	Research Area, Output, or Product Title
<b>Research Area 1: Approaches to Support Air Quality Management for Multiple Pollutants at Multiple Scales</b>	
AE.1.5.6	Summary of Spatial Analysis of Volatile Organic Compounds in Rubbertown Area of Louisville, Kentucky using Passive Samplers
AE.1.6.10	Development of a VCP Emission Inventory Methodology and Tool
AE.1.6.2	Summary of Implications of VCPs for Ozone and PM in Urban Atmospheres (California and the Northeast US)
AE.1.6.4	Summary of Identification of VCP-driven Criteria Pollutant Exceedances Nationwide in the Context of Changing NOx
AE.1.6.5	Summary of Laboratory Determination of SOA and Ozone from Volatile Chemical Products (VCPs)
AE.1.6.8	Summary of a Multimodel Approach to Chemical Prioritization Based on Primary and Secondary Pollutant Exposure Across Environments Resulting from Volatile Chemical Products
<b>Research Area 2: Approaches for Characterizing Source Emissions, Air Quality, Exposure, and Mitigation Strategies</b>	
AE.2.1.3	Summary and dataset on emissions characterization of NOx, VOC, SVOC, PM emissions from both light and heavy-duty vehicles
AE.2.1.5	Summary of emissions from off-road stationary diesel gensets operating on traditional and alternative fuels
AE.2.1.6	The SPECIATE Database
AE.2.1.9	Summary of Investigation of Stationary Source Condensable PM Measurements
<b>AE.2.2</b>	<b>Output: Development, Evaluation, and Implementation of Updated Ambient Air Measurement Methods</b>
<b>AE.2.3</b>	<b>Output: Progress update on fugitive, area source, fenceline, and roadway emissions research</b>
AE.2.3.1	Summary of Emission Factors of Reduced Nitrogen and Sulfur Compounds from Biomass Combustion
AE.2.3.3	FY20 Annual Summary of NGEM and Fugitive, Area Source, and Fenceline Research
AE.2.3.4	FY21-22 Annual Summary of NGEM and Fugitive, Area Source, and Fenceline Research
AE.2.3.5	Dataset of PM Speciation Results of Brake and Tire Wear Collected from On-Road Motor Vehicles
AE.2.3.6	Summary of results of field evaluation of portable automated gas chromatographs for near source VOC monitoring
<b>AE 2.5</b>	<b>Output: Emission Estimating Methodologies (EEMs) and future research needs for emissions from agricultural sources</b>
AE.2.5.1	Draft Emission Estimating Methodologies (EEMs) for ammonia, hydrogen sulfide, and particulate matter emissions from swine, poultry (broiler and layer), and dairy farms
AE.2.6.1	Summary of Temporal Patterns and Biophysical Controls on Methane Emissions from Reservoirs
AE.2.6.2	An Estimate of Methane Emissions for U.S. Reservoirs for Inclusion in the Annual Inventory of U.S. Greenhouse Gas Emissions and Sinks
<b>Research Area 4: Public Health and Environmental Exposures and Responses to Emerging Air Pollutants and Sources</b>	
<b>4.1</b>	<b>Output: State-of-the Science: Synthesis of Research on Airborne PFAS Emissions, Sources, Measurement Methods, Control, Dispersion, Environmental Fate, and Impacts and Identification of Remaining Critical Knowledge Gaps</b>

ID	Research Area, Output, or Product Title
AE.4.1.1	PFAS Source Emissions Measurement Methods and Approaches
AE.4.1.10	Summary of Modeling PFAS Air Emissions, Chemistry, and Deposition
AE.4.1.11	Summary of Computational Study of the Atmospheric Lifetimes and Fate of Volatile Perfluoroalkyl Substances (PFAS)
AE.4.1.12	Summary of Characterization and Mitigation of PFAS Air Emissions from Fabric Thermal Application Processes
AE.4.1.13	PFAS Literature Review Paper - Air Sources and Pathways for Perfluorinated Compounds
AE.4.1.14	Modeling PFAS Air Fate and Transport in the Eastern U.S.
AE.4.1.15	Other Test Method (OTM)-45 for PFAS Compounds
AE.4.1.2	PFAS Source Emissions Measurement Methods - Summary of Field Evaluation and Validation
AE.4.1.3	Summary of PFAS Source Emission Characterization
AE.4.1.4	Ambient Air Measurement Approaches for PFAS Compounds
AE.4.1.5	Summary of Field Evaluations of Ambient Air Measurement Approaches for PFAS Compounds
AE.4.1.6	Summary of PFAS Ambient Air Characterization
AE.4.1.7	Atmospheric Deposition Measurement Approaches for PFAS Compounds
AE.4.1.8	Summary of Field Evaluations of Atmospheric Deposition Methods for PFAS Compounds
AE.4.1.9	Summary of PFAS Wet Deposition Characterization
<b>AE.4.3</b>	<b>Output: Ethylene Oxide - State of the Science and Methods Development</b>
AE.4.3.3	Summary of Field Evaluation of Current EPA Method TO-15A Analysis for Ambient Monitoring of Ethylene Oxide
AE.4.3.4	Toxic Organics Method TO-15A Supplement, Canister Analysis Method for Ethylene Oxide in Ambient Air
AE.4.3.5	Summary of EtO Emissions from Motor Vehicles
AE.4.3.7	Improved Characterization of Atmospheric Chemistry of EtO
AE.4.3.8	Summary of Instrumentation and Measurement Capabilities for Source Emissions of EtO
AE.4.3.9	Summary of Instrumentation and Measurement Capabilities for Background and Near-Source Emissions of EtO

## CQ2: Science Needs to Understand Climate Change Impacts

The following table lists anticipated Air, Climate, and Energy (ACE) deliverables relevant to Charge Question 2. The Outputs and Products may change as new scientific findings emerge. Completion of Outputs and Products is contingent on appropriate resources being available. ACE will continue to actively engage with EPA Partners to meet their needs and inform the reviews of the NAAQS and implementation strategies.

ID	Research Area, Output, or Product Title
<b>Research Area 1: Approaches to Support Air Quality Management for Multiple Pollutants at Multiple Scales</b>	
AE.1.3.5	Estimated Decadal-scale Changes in Background Pollution Due to Divergent Trends in Global Emissions
<b>Research Area 6: Methods to enable resilience to future environmental stressors</b>	
<b>AE.6.1</b>	<b>Output: Updated and expanded scenario data for population, land use, and extreme events to inform risk communication and management</b>
AE.6.1.1	Updated LASSO Web Application
AE.6.1.2	ICLUS Scenario Data
AE.6.1.3	Dynamically downscaled projections of changes to extreme weather across the CONUS
AE.6.1.4	Projected changes to IDF curves from dynamically downscaled scenarios
AE.6.1.5	Summary of improved high-resolution simulation of extreme weather events
<b>AE.6.2</b>	<b>Output: Summary of Advancements in Interactions of Environmental Changes on PM, Ozone, Wildfires and Associated Human Health Impacts</b>
AE.6.2.1	Summary of changes in air quality and health impacts in the U.S. at 2050 and 2090 projected using multiple earth system models and emission scenarios
AE.6.2.2	Summary of projected air quality and health impacts of wildfire in the U.S. under different temperature scenarios
AE.6.2.3	Summary of estimated relationship between national temperatures and air quality (O3/PM2.5 concentrations) based on multiple models
<b>AE.6.3</b>	<b>Output: Analysis of environmental impacts and vulnerabilities due to effects of changing conditions and extreme events on water quality and aquatic resources</b>
AE.6.3.1	Summary of coastal water program risk mapping and adaptation analysis for resilient infrastructure
AE.6.3.2	Summary of hydroclimatic change effects on stormwater BMPs in different regions of the U.S.
AE.6.3.3	National Stormwater Calculator Update – informing management of extreme storm events
AE.6.3.4	Summary of the effects of extreme events on and emerging risks to forested watersheds
AE.6.3.5	Summary of impacts to watersheds from wildland fire and extreme events on salmonid refugia and population viability
AE.6.3.6	Identification of resilient watershed BMPs under scenarios of future climate and land-use change: Regions 1, 3, 6, and 7 case studies
<b>AE.6.4</b>	<b>Output: Methods for adaptation planning and decision analysis to improve environmental resilience to changing conditions and extreme events</b>
AE.6.4.1	Report estimating site-specific gains and losses of tidal wetland ecosystem services due to sea level rise and extreme weather events
AE.6.4.2	Report characterizing and assessing the resilience and recovery potential of watersheds challenged by extreme events to identify key refugia
AE.6.4.3	Report on the application of vulnerability assessment results and innovative methods to identify resilient sites and assess trends
AE.6.4.4	Synthetic principles for adaptation planning and decision analysis to improve resilience of natural resources under changing environmental conditions

### CQ3: Science Needs for Impacts of Changing Energy Systems

*The following table lists anticipated Air, Climate, and Energy (ACE) deliverables relevant to Charge Question 3. The Outputs and Products may change as new scientific findings emerge. Completion of Outputs and Products is contingent on appropriate resources being available. ACE will continue to actively engage with EPA Partners to meet their needs and inform the reviews of the NAAQS and implementation strategies.*

ID	Research Area, Output, or Product Title
<b>Research Area 5: Methods to evaluate environmental benefits and consequences of changing energy systems</b>	
<b>AE.5.1</b>	<b>Output: Report on air quality under future energy scenarios</b>
AE.5.1.2	Summary of method and an analysis using the method for projecting future-year emission inventories for non-EGU sources such as industrial sources
AE.5.1.3	Characterization of cost and emissions savings associated with Energy Efficiency and Renewable Energy to support control strategy development
AE.5.1.4	Summary of formal scenarios methods to investigate the efficacy of existing regulations and potential policies in protecting air quality
AE.5.1.5	Updates and improvements to GLIMPSE framework
AE.5.1.6	Summary of NYC Ozone Responsiveness to Regional and Local NOX Reductions: A Multi-sector analysis
<b>AE.5.2</b>	<b>Output: Biofuels and the Environment: The Third Triennial Report to Congress (RtC3)</b>
AE.5.2.1	Technical Input White Papers for de novo analyses for the RtC3
AE.5.2.3	External Review Draft (ERD) for the RtC3
AE.5.2.4	White paper describing foundation for RtC4
<b>AE.5.3</b>	<b>Output: Progress update on environmental consequences of emerging transportation technologies, policies, and practices</b>
AE.5.3.1	Analysis of the energy and emission implications of deploying low-emission hydrogen fuels in the transportation sector
AE.5.3.2	Updated GCAM-USA model with enhancements to support Agency applications

The following tables list projects that are relevant to the Charge Questions and supported through the Science to Achieve Results (STAR) extramural grants and other supplemental internal ORD programs.

### ***Science Needs Related to Air Toxic Sources and Emerging Contaminants (CQ1)***

Solicitation or Project Title (PI, Institution)	Project Type <sup>1</sup>	Start Date	# Journal Articles
<b>Solicitation: Measurement and Monitoring Methods for Air Toxics and Contaminants of Emerging Concern in the Atmosphere</b>			
N/A	STAR	April 2022 (anticipated)	

Supplemental ORD Project Title	Lead Region	Project Type <sup>1</sup>	Fiscal Year(s)
Ambient Air Monitoring and Emissions Controls for PFAS	Region 3	ROCS-Net	2019
Understanding PFAS Deposition	Region 1	ROCS-Net	2019
Evaluating PFAS Waste Treatment and Disposal Technology Effectiveness	Region 9	R2P2	2019
Ethylene Oxide: Developing Enhanced Monitoring Capabilities	Region 5	R2P2	2020
Advanced fugitive measurements of ethylene oxide emissions	Region 5	RARE	2019
Equipment Familiarization and Development of Real Time Ethylene Oxide (EtO) Analyzer Deployment Parameters	Region 7	R2P2	2020
Characterization of EtO Emissions Downwind of a Chemical Facility Using Innovative Realtime Measurement Technologies	Region 7	RARE	2021
Comparison of Particulate Metals Passive Air Samplers Against Semi-Continuous Metals Monitor near Steel Mills and Other Metal Emitting Facilities	Region 5	RARE	2021 2022
In-Source Monitoring at the Port of New York and New Jersey	Region 2	RARE	2011
Measurement of combustion efficiency of enclosed combustor devices (ECDs) at oil and natural gas production facilities	Region 8	RARE	2020
Next Generation Emissions Measurements and Source Modeling at Gasoline Bulk Terminals	Region 4	RARE	2021
Development and testing of fenceline sensor systems in EPA Region 6	Region 6	RARE	2017
Demonstration of advanced fenceline VOC monitoring systems in New Mexico	Region 6	RARE	2020
Community Participation in Classifying Odors from Air Pollution Emissions	Region 4	RESES	2018
Utilizing low-cost Next Generation Emissions Measurement (NGEM) tools to develop a near-source monitoring and modeling approach for air toxics emissions	Region 4	R2P2	2020

<sup>1</sup> Project types are defined at the end of this document.

## Science Needs to Understand Climate Change Impacts (CQ2)

Solicitation or Project Title (PI, Institution)	Project Type	Start Date	# Journal Articles
<b>Solicitation: Particulate Matter and Related Pollutants in a Changing World</b>			
Wildfires in the Rocky Mountains Region: Current and Future Impacts on PM2.5, Health, and Policy (PI: Yan Liu, Georgia Institute of Technology)	STAR	January 2016	5
Rethinking the Formation of Secondary Organic Aerosols (SOA) Under Changing Climate by Incorporating Mechanistic and Field Constraints (PI: Jose Jimenez, University of Colorado- Boulder)	STAR	January 2016	52
Ensemble Analysis of Global Change Projections for US Air Quality Using a Novel Combination of Lagrangian and Gridded Air Quality Models (PI: Brian Lamb, Washington State University)	STAR	January 2016	N/A
Particulate Matter Prediction and Source Attribution for U.S. Air Quality Management in a Changing World (PI: Xin-Zhong Liang, University of Maryland)	STAR	April 2016	6
Quantifying Risks from Changing U.S. PM2.5 Distributions Due to Climate Variability and Warming with Large Multi-Model Ensembles and High-Resolution Downscaling (PI: Arlene Fiore, Columbia University)	STAR	January 2016	9
Integrated Analysis of Land Use-Based Policies for Improving Air and Water Quality: A Focus on Agricultural Reactive Nitrogen and Wildland Fire Emissions as Climate, Land Use and Anthropogenic Emissions Change (PI: Ted Russell, Georgia Tech)	STAR	January 2016	16
Effects of Ammonia on Secondary Organic Aerosol Formation in a Changing Climate (PI: Donald Dabdub, University of California-Irvine)	STAR	January 2016	8
Interplay Between Black and Brown Carbon from Biomass Burning and Climate (PI: Shane Murphy, University of Wyoming)	STAR	January 2016	2
Effects of Changes in Climate and Land Use on U.S. Dust and Wildfire Particulate Matter (PI: Loretta Mickley, Harvard University)	STAR	January 2016	7
Planning for an Unknown Future: Incorporating Meteorological Uncertainty into Predictions of the Impact of Fires and Dust on US Particulate Matter (PI: Emily Fischer, Colorado State University)	STAR	January 2016	8
<b>Solicitation: Air, Climate And Energy (ACE) Centers: Science Supporting Solutions</b>			
SEARCH: Solutions to Energy, Air, Climate, and Health (PI: Michelle Bell, Yale University); (Project 3: Air Quality and Climate Change Modeling: Improving Projections of the Spatial and Temporal Changes of Multipollutants to Enhance Assessment of Public Health in a Changing World)	STAR	October 2015	69
Regional Air Pollution Mixtures: The past and future impacts of emissions controls and climate change on air quality and health (PI: Petros Koutrakis, Harvard University); (Project 1: Regional Air Pollution Mixtures: The Past and Future Impacts of Emission Controls and Climate Change on Air Quality and Health)	STAR	December 2015	162

Supplemental ORD Project Title	Lead Region	Project Type	Fiscal Year(s)
Quantification of Landfill Gas Emissions using next generation emission measurement (NGEM) approaches	Region 5	RARE	2021 2022

### Science Needs for Impacts of Changing Energy Systems (CQ3)

Solicitation or Project Title (PI, Institution)	Project Type	Start Date	# Journal Articles
<b>Solicitation:</b>			
<b>Particulate Matter and Related Pollutants in a Changing World</b>			
Evaluating the Timeline of Particulate Matter Exposure from Urban Transportation and Land-Use Greenhouse Gas Mitigation Strategies Using a Novel Modeling Framework (PI: Greg Rowangould, University of Vermont)	STAR	January 2016	3
Optimal Energy Portfolios to Sustain Economic Advantage, Achieve GHG Targets, and Minimize PM2.5. (PI: Mike Kleeman, University of California-Davis)	STAR	April 2016	3
<b>Solicitation:</b>			
<b>Air, Climate And Energy (ACE) Centers: Science Supporting Solutions</b>			
SEARCH: Solutions to Energy, Air, Climate, and Health (PI: Michelle Bell, Yale University); (Project 1: Modeling Emissions from Energy Transitions); (Project 4: Human Health Impacts of Energy Transitions: Today and Under a Changing World)	STAR	October 2015	69
Center for Air, Climate, and Energy Solutions (CACES) (PI: Allen Robinson, Carnegie Mellon); (Project 4: Air Pollutant Control Strategies in a Changing World)	STAR	May 2016	75

Supplemental ORD Project Title	Lead Region	Project Type	Fiscal Year(s)
State-level multi-pollutant planning using GLIMPSE	Region 3	RARE	2019
Improving State-Level Multi-Pollutant Planning in Connecticut with GLIMPSE	Region 1	RARE	2021

## ***STAR and Other ORD Programs Providing Supplemental Funding***

Extramural Research funded through EPA's Science to Achieve Results (STAR) grants provides invaluable engagement between the agency and scientific community, fostering a collaboration and knowledge-sharing platform. These grants not only engage top scientists throughout the U.S., resulting in a strong scientific foundation to support the Agency in meeting its mission, but the resulting funded research provides the underlying scientific and engineering knowledge needed to address environmental and human health issues and to improve decision-making, problem detection, and problem-solving.

EPA's Small Business Innovation Research (SBIR) Program is the small program with a big mission: to protect human health and the environment. Broad areas of focus typically stay the same and include clean and safe water, air quality, land revitalization, homeland security, sustainable materials management and safer chemicals. More specific subtopics under each of these broad areas change from year to year.

Regional Applied Research Effort (RARE) Program: The RARE program provides a mechanism for ORD and the regions to collaborate on near-term regional research priorities. RARE research addresses a wide range of environmental issues, from human health concerns to ecological effects of various pollutants. The RSLs coordinate RARE activities and ensure that research results are effectively communicated and used within the regions.

Regional Research Partnership Program (R2P2): R2P2 provides short-term training opportunities for regional technical staff to work directly with ORD scientists in ORD laboratories, centers, and offices. The program builds technical capacity in the regions, enhances the skills and knowledge of regional and ORD staff, and promotes the development of stronger ties between ORD and the regions. The RSLs and headquarters staff facilitate the process of soliciting applicants and helping candidates establish the necessary contacts throughout ORD.

The Regional Sustainability and Environmental Sciences (RESES) program, led by EPA's Office of Research and Development (ORD), matches Agency scientific and technical expertise with high-priority, short-term research needs in each of the Agency's ten Regions across the nation.

Regional/ State/ Tribal Innovation Projects: The RSTIP program provides competitive funding for regional/state/tribal projects that use innovative approaches to address regional, state, and/or tribal science priorities. The program encourages the use of innovative approaches – citizen science and crowdsourcing, advanced monitoring technologies, and social science – which can expand and diversify EPA's work, engage the public, and foster creative solutions to important environmental problems. This also provides a valuable opportunity to continue strengthening the relationship between ORD, regions, states, and tribes.

Pathfinder Innovation Projects (PIPs) challenge EPA scientists to explore the leading edge of environmental science and work to turn innovations in science and technology into new environmental protection capabilities. This internal competition provides staff with additional research time and funding in pursuit of high-risk, high reward research ideas.

**U.S. EPA Office of Research and Development (ORD)**  
**Board of Scientific Counselors (BOSC)**  
**Air, Climate, and Energy Subcommittee (ACE SC)**  
**for the Air, Climate, and Energy (ACE) Research Program**

**Tuesday, October 12, 2021**

Time (EDT)	Agenda Activity	Presenter
10:30 – 11:00	Sign on & Technology Check	
11:00 – 11:15	Welcome and Opening Remarks	Tom Tracy, Designated Federal Officer (DFO)  Charlette Geffen, ACE BOSC SC Chair Sandy Smith, ACE BOSC SC Vice Chair
11:15 -11:30	ORD Welcome	Wayne Cascio, ORD Acting Principal Deputy Assistant Administrator for Science  Chris Frey, ORD Deputy Assistant Administrator for Science Policy
11:30 – 11:45	Overview of ACE BOSC SC Meeting Format and Charge Questions	Bryan Hubbell ACE National Program Director (NPD)
11:45 – 11:55	Update on BOSC EC PFAS Research Discussion	Susan Burden, OSAPE
<b>Charge Question 1</b>		
11:55 – 12:10	<b>CQ1:</b> Science Needs Related to Air Toxic Sources and Emerging Contaminants (Research Areas 2 and 4)	Bryan Hubbell, ACE NPD
12:10 – 12:25	Approaches for Addressing Scientific Challenges and Key Uncertainties in Characterizing Air Toxics and Contaminants of Emerging Concern	Alice Gilliland, Acting Center Director, Center for Environmental Measurement and Modeling (CEMM)
12:25 – 1:55	Research to Understand Source Emissions and Ambient Concentrations of Air Toxics and Contaminants of Emerging Concern	Tiffany Yelverton, CEMM Richard Shores, CEMM Alan Vette, CEMM Chet Wayland, OAR
1:55 – 2:10	<b>BREAK</b>	
2:10 – 4:10	<b>Meet the Scientists, Session #1</b>	
	<b>Room A</b>	
	Air Toxics – Source Measurement and Methods, Session Lead	Wyat Appel, CEMM
	PFAS Methods Development	Jeff Ryan, CEMM
	Fenceline Measurements and Methods Development	Eben Thoma, CEMM
	PFAS Incineration	Jonathan Krug, CEMM
	<b>Room B</b>	
	Air Toxics – Ambient Measurement and Methods, Session Lead	Mike Hays, CEMM
	VOCs/Odor Explore App	Rachelle Duvall, CEMM
	EtO Ambient Measurement and Methods Development	Ingrid George, CEMM

Time (EDT)	Agenda Activity	Presenter
	Air Toxics Ambient Measurement and Methods Development	Tamira Cousett, CEMM
	<b>Room C</b>	
	Air Toxics Modeling and Databases, Session Lead	Donna Schwede, CEMM
	Incorporating PFAS into the CMAQ Model	Emma D'Ambro, CEMM
	Updates to the SPECIATE database	George Pouliot, CEMM
	Adding VCP Chemistry to CMAQ	Havala Pye, CEMM
4:10 – 4:25	<b>BREAK</b>	
4:25 – 4:40	Public Comments	Tom Tracy, DFO
4:40 – 5:15	Clarification Questions from BOSC SC	Charlette Geffen, ACE BOSC SC Chair Sandy Smith, ACE BOSC SC Vice Chair
5:15 – 6:15	Working Session for BOSC SC Discussion	

### Wednesday, October 13, 2021

Time (EDT)	Agenda Activity	Presenter
10:30 – 11:00	Sign on & Technology Check	
11:00 – 11:15	Welcome Back	Tom Tracy, DFO Charlette Geffen, ACE BOSC SC Chair Sandy Smith, ACE BOSC SC Vice Chair
<b>Charge Question 2</b>		
11:15 -11:30	<b>CQ2:</b> Science Needs to Understand Climate Change Impacts (Research Area 6)	Andy Miller, ACE Associate NPD for Climate
11:30 – 11:45	Approaches to Understand and Prepare for Climate-Driven Impacts	Tim Watkins or TBD, Acting Center Director, Center for Public Health and Environmental Assessment (CPHEA)
11:45 – 1:15	Research to Understand Climate Impacts and to Enable Resilience	Peter Beedlow, CPHEA Britta Bierwagen, CPHEA Chris Weaver, CPHEA Stephanie Santell, OW Dan Brown, R10 Jeremy Martinich, OAP
1:15 – 1:30	<b>BREAK</b>	
1:30 – 3:30	<b>Meet the Scientists, Session #2</b>	
	<b>Room A</b>	
	Water Quality and Aquatic Resources, Session Lead	Darrell Winner, CPHEA
	Stormwater Best Management Practices	Tom Johnson, CPHEA
	Adaptation Planning Frameworks	Jordan West, CPHEA
	Regional Watershed Resilience	Naomi Detenbeck, CEMM
	<b>Room B</b>	
	Ecosystem Effects, Session Lead	Peter Beedlow, CPHEA
	Coldwater Fish Refugia	Joe Ebersole, CPHEA

Time (EDT)	Agenda Activity	Presenter
	Nutrient Transport	Jana Compton, CPHEA
	<b>Room C</b>	
	Scenarios and Impacts, Session Lead	Tanya Spero, CEMM
	Global Change Explorer	Phil Morefield, CPHEA
	Storm IDF curves	Anna Jalowska, CPHEA
3:30 – 3:45	<b>BREAK</b>	
3:45 – 4:15	Public Comments	Tom Tracy, DFO, OSAPE
4:15 – 4:45	Clarification Questions from BOSC SC	Charlette Geffen, ACE BOSC SC Chair Sandy Smith, ACE BOSC SC Vice Chair
4:45 – 5:30	Working Session for BOSC SC Discussion	

### Thursday, October 14, 2021

Time (EDT)	Agenda Activity	Presenter
10:30 – 11:00	Sign on & Technology Check	
11:00 – 11:15	Welcome Back	Tom Tracy, DFO, OSAPE Charlette Geffen, ACE BOSC SC Chair Sandy Smith, ACE BOSC SC Vice Chair
<b>Charge Question 3</b>		
11:15 – 11:25	<b>CQ3:</b> Science Needs for Impacts of Changing Energy Systems (Research Area 5)	Sherri Hunt, ACE Principal Associate NPD
11:25 – 12:15	Approaches and Research to Understand Impacts of Changing Energy Systems	Darrell Winner, CPHEA Rebecca Dodder, CEMM Marcus Sarofim, OAP Shutsu Wong (R1)
12:15 – 12:30	<b>BREAK</b>	
12:30 – 2:00	<b>Meet the Scientists Session #3</b>	
	<b>Room A</b>	
	Energy Systems Modeling and Databases, Session Lead	Tom Pierce, CEMM
	GLIMPSE	Dan Loughlin, CEMM
	EPAUS9r-TIMES	Carol Lenox, CEMM
	CoMET	Ozge Kaplan, CEMM
	<b>Room B</b>	
	Biofuels, Session Lead	Britta Bierwagen, CPHEA
	Biofuels Report to Congress	Chris Clark, CPHEA
	Terrestrial Effects of Land Use Change	Steve LeDuc, CPHEA
2:00 – 2:15	<b>BREAK</b>	
2:15 – 3:15	Revitalizing Research to Address the Challenge of Climate Change	Bryan Hubbell, ACE NPD Andy Miller, ACE ANPD for Climate
3:15 – 4:00	Clarification Questions from BOSC SC	Charlette Geffen, ACE BOSC SC Chair Sandy Smith, ACE BOSC SC Vice Chair
4:00 – 5:00	BOSC SC Workgroup Breakouts	
5:00 – 5:45	BOSC SC Workgroup Reports	
5:45 – 6:00	Wrap up and Next Steps	Charlette Geffen, ACE BOSC SC Chair Sandy Smith, ACE BOSC SC Vice Chair

6:00	Adjourn	Tom Tracy, DFO
------	---------	----------------

### Meet the Scientists Sessions

- ACDs will plan details of these sessions.
- Meet the Scientists sessions promote smaller group interactions with researchers.
- Each Meet the Scientists session has multiple time blocks/virtual rooms and will:
  - Focus on a specific topic, and
  - Have a moderator and scientists, each with short presentations, with time for group/topic discussion.
- Within a Meet the Scientist Session, each block/virtual room will repeat so that **all subcommittee members will be able to attend all virtual rooms**. Subcommittee members will be assigned a group and will rotate through the virtual rooms.

**U.S. EPA Office of Research and Development  
Charge to the Board of Scientific Counselors (BOSC)  
Subcommittee for the Air, Climate, and Energy Research Program  
Virtual Meeting on October 12-14, 2021**

**Introduction:** The mission of the EPA Office of Research and Development (ORD) is to provide the best available science and technology to inform and support public health and environmental decision making at federal, state, tribal, and local levels. Having incorporated BOSC recommendations into the planning phase for ORD's Air, Climate, and Energy (ACE) national research program, ORD is now seeking BOSC input focused on implementation of the research portfolio.

The ACE research program includes nine research areas (RAs) which will be addressed over two ACE BOSC Subcommittee meetings in 2021. Each BOSC meeting will focus on specific themes and emphasize different elements of the ACE portfolio to illustrate core capabilities and innovative thinking to address critical partner research needs. By the end of this cycle, the ACE BOSC Subcommittee will have been provided an implementation overview of all nine ACE RAs and more in-depth information on a selected set of research deliverables (products and outputs). To illustrate ACE's integrated and partner-oriented approach, information will be provided at the October '21 BOSC subcommittee meeting on three areas of focus:

- 1) Characterizing source emissions and developing ambient measurement methods for air toxics and contaminants, especially those related to emerging pollutants of concern,
- 2) Understanding the impacts of a changing climate and developing solutions for adapting to those impacts, and
- 3) Modeling the impacts of the Nation's transforming energy and transportation systems.

The Agency is moving forward to tackle Administration priorities of addressing the climate crisis and environmental justice issues. Existing work under the current ACE strategic plan contributes to understanding and addressing these two issues. The meeting format will include an introduction to scientific challenges, examples of work within the ORD Research Centers to address these challenges, and an opportunity to interact with scientists leading specific research activities. Please note that only selected air-related aspects of PFAS will be covered in this BOSC subcommittee review, with the broader aspects of ORD's PFAS research portfolio being reviewed by the BOSC Executive Committee in a separate process.

**Charge Questions:**

Q1: The ACE research program is implementing research to develop new methods to quantify source and near-source emissions, as well as ambient levels, of toxic air pollutants and contaminants of emerging concern. These methods are needed to identify pollutant sources and levels of exposure for communities and individuals.

*What suggestion(s)/recommendation(s) does the Subcommittee have on ORD's implementation of its air toxics and contaminants of emerging concern measurements methods research, and how this research will improve our understanding of these pollution sources and exposures, particularly for disproportionately impacted communities? [RA1, RA2, RA4]*

Q2: Climate change is expected to continue to increase the negative environmental and human health impacts of wildfires, flooding, drought, and other extreme events. Developing the knowledge and

approaches to build resilience and adapt to these events is critical to preparing communities and protecting vulnerable populations and ecosystems.

*What suggestion(s)/recommendation(s) does the Subcommittee have on ORD's implementation of research to understand effects of climate-driven changes on natural and human systems, adverse impacts on human health and the environment from climate stressors, and approaches to prevent or reduce these impacts? [RA6]*

Q3: The Nation's energy and transportation systems are experiencing major transformations in response to economic drivers and to meet the Biden Administration's goal of net-zero carbon emissions by 2050. Understanding the dynamic changes in these complex, interconnected systems is important for understanding impacts of policies and technology changes on emissions of greenhouse gases, air pollutants, and other health and environmental impacts.

*What suggestion(s)/recommendation(s) does the Subcommittee have on ORD's implementation of its research portfolio to gain a better understanding of how energy and transportation systems may evolve and the consequences for emissions and other impacts. [RA5]*

## Summary of Product and Output Information for the Air and Energy 2019-2022 StRAP

*Last Updated: September 23, 2021*

This table summarizes the Air and Energy (A-E) Products and Outputs completed and delivered in FY19, FY20, and FY21 supporting the 2019-2022 A-E Strategic Research Action Plan (StRAP).<sup>1</sup> Publicly available Product and Output materials can be accessed via links. Drafts of papers that have been submitted, but not yet published, and internal reports are only available to those within EPA. Related links in the final column contain general, publicly available information related to the Product or Output.

Research Area	Product or Output Number <sup>2</sup>	Product or Output Title	Product or Output Materials and Related Links <sup>3</sup>
1	AE.1.1	Output: Release of CMAQ v5.3 and Instrumented Versions Supporting Source Apportionment	<a href="#">CMAQ Website</a> ; <a href="#">CMAQ Fact Sheet</a>
1	AE.1.2.1	Product: Evaluation of CMAQv5.3	<a href="#">Appel et al, 2020 (submitted)</a> ; <a href="#">Presentation, 2019 CMAS</a> ; <a href="#">CMAQ Website</a> ; <a href="#">CMAQ Fact Sheet</a>
1	AE.1.3.1	Development, Evaluation, and Application of a Multi-scale Modeling Platform to Estimate Ozone Concentrations and Source Contributions Over the Greater Denver Area	<a href="#">Matichuk et al. 2020</a> ; <a href="#">CMAS Presentation (Oct 2020)</a>
1	AE.1.5.1	Product: Development of Algorithm for Solid Noise Barrier for Use in Dispersion Models	<a href="#">Heist et al, 2020 (submitted)</a> ; <a href="#">AMS 2020 Presentation</a> ; <a href="#">Near Roadway Website</a> ; <a href="#">Science Matters Barriers</a>
1	AE.1.5.6	Product: Spatial Analysis of Volatile Organic Compounds in Rubbertown Area of Louisville, Kentucky using Passive Samplers	<a href="#">Mukerjee et al, 2020</a> .
1	AE.1.6.2 (formerly AE.4.2.2)	Product: Summary of Implications of VCPs for Ozone and PM in Urban Atmospheres (California and the Northeast US)	<a href="#">Qin et al, 2020</a> ; <a href="#">Presentation, 2019 CMAS</a> ; <a href="#">CMAQ VCP Webpage</a>
1	1.6.10	Development of a VCP Emission Inventory Methodology and Tool	<a href="#">Seltzer et al, 2021</a>
2	AE.2.1.1	Product: Description of carbonaceous particle emissions from a pellet-burning biomass boiler	<a href="#">Hays et al, 2019</a>
2	AE.2.1.2	ISO-protocol, mutagenicity potential research evaluation of biomass pellet fuels for household energy applications	<a href="#">Champion et al, 2020</a> ;
2	AE.2.2.1	Product: Comparison of Ozone Measurement Methods in Biomass Burning Plumes	<a href="#">Long et al, 2020</a>

<sup>1</sup> Products and Outputs from the 2016-2019 StRAP are not included here in order to focus on implementation of the existing plans.

<sup>2</sup> Two-digit numbers identify Outputs and three digit numbers identify Products.

<sup>3</sup> Includes Websites, Webpages, Fact Sheets, and/or articles from ORD's public newsletter Science Matters containing related information.

## Summary of Product and Output Information for the Air and Energy 2019-2022 StRAP

Last Updated: September 23, 2021

Research Area	Product or Output Number <sup>2</sup>	Product or Output Title	Product or Output Materials and Related Links <sup>3</sup>
2	AE.2.2.2	Evaluation of Small Form Factor, Battery Powered, Filter Based PM Samplers for Use in Community Monitoring during Wildland Fire Smoke Events	
2	AE.2.2.4	Product: FY20 Activity Report of ORD's Reference and Equivalent Methods Designation Program	Internal Report; <a href="#">AMTIC Website</a> ; <a href="#">Criteria Pollutants Webpage</a>
2	2.2.6	FY21 Activity Report of ORD's Reference and Equivalent (R&E) Methods Designation Program	Fiscal Year 2021 Activity Report for the Reference and Equivalent Methods Designation Program
2	AE.2.4	Output: Summary of research advancements to characterize emissions, exposures, and related health and environmental impacts associated with solid-fuel combustion for household energy needs (cooking, heating, and lighting) and outline of priorities for future research	State-of-the-Science Webinar <sup>4</sup> ; <a href="#">Household Energy Webpage</a>
2	AE.2.6.1	Product: Summary of Temporal Patterns and Biophysical Controls on Methane Emissions from Reservoirs	Waldo et al, 2020 (submitted)
2	AE.2.2.8	Recommendations for Nationwide Approval of Nafion™ Dryers Upstream of UV-Absorption Ozone Analyzers	<a href="#">Public EPA Report</a>
2	2.2.9	Evaluation of Two Collocated Federal Equivalent Method PM2.5 Instruments, Including Under High Particle Concentrations	Hagler et al, 2021 (draft)
2	AE.2.3.3	FY20 Annual Summary of Next Generation Emission Measurements (NGEM) and Fugitive, Area Source, and Fenceline Research	FY20 Annual Summary of NGEM and Fugitive, Area Source, and Fenceline Research; <a href="#">Mukerjee et al, 2020</a> ; <a href="#">Brantley et al, 2019</a> ; <a href="#">Stovern et al, 2020</a> ; <a href="#">Zimmerle et al, 2020</a>
2	AE.2.3.8	Emission Sampling from Wildland Fires to Inform Improved Emission Factors	<a href="#">Aurell et al, 2021</a> ; <a href="#">AirNow Sensor Data Pilot Webinar (Jan 2021)</a> ; <a href="#">EPA Tools and Resources Webinar (May 2021)</a> ; <a href="#">Website</a>
3	AE.3.1/3.1.1	Output and Product: Synthesis of progress to improve characterization of deposition budgets for North America and identification of remaining critical knowledge gaps related to nitrogen deposition and assessments of critical loads	<a href="#">Walker et al., 2019</a>

<sup>4</sup> Slides are not posted but were made available to webinar participants upon request.

# Summary of Product and Output Information for the Air and Energy 2019-2022 StRAP

Last Updated: September 23, 2021

Research Area	Product or Output Number <sup>2</sup>	Product or Output Title	Product or Output Materials and Related Links <sup>3</sup>
4	AE.4.1.10	Product: Summary of Modeling PFAS Air Emissions, Chemistry, and Deposition	<a href="#">D'Ambro et al, 2020</a> ; <a href="#">PFAS Webpage</a>
4	AE.4.1.13	PFAS Literature Review Paper - Air Sources and Pathways for Perfluorinated Compounds	<a href="#">Owens 2021</a>
4	AE.4.1.15	Other Test Method 45 (OTM-45) Measurement of Selected Per- and Polyfluorinated Alkyl Substances from Stationary Sources	<a href="#">Test Method Document</a>
4	AE.4.3.3	Product: Summary of Field Evaluation of Current EPA Method TO-15A Analysis for Ambient Monitoring of Ethylene Oxide	Internal Report
5	AE.5.2.1	Product: Technical Input White Papers for de novo analyses for the Third Biofuels Report to Congress	Internal Literature Review; Internal Attribution White Paper; Biomass Scenario Model; <a href="#">Second Biofuels Report to Congress</a>
5	AE.5.3.1	Analysis of the energy and emission implications of deploying low-emission hydrogen fuels in the transportation sector	Presentation
6	AE.6.2.1	Product: Summary of changes in air quality and health impacts in the U.S. at 2050 and 2090 projected using multiple earth system models and emission scenarios	<a href="#">Nolte et al, 2020 (submitted)</a> ; <a href="#">Fann et al, 2020 (submitted)</a>
7	AE.7.2.1	Product: Report on Stakeholder Needs Assessment for Air Sensors	<a href="#">Presentation</a> ; Internal Report
7	AE.7.3.1	Product: Air Sensor Performance Targets and Test Protocols for PM <sub>2.5</sub> and Ozone	Ozone Internal Report; PM Internal Report; ASIC 2020 <a href="#">Presentation</a> ; <a href="#">Air Sensor Toolbox</a>
7	AE.7.3.5	Product: EPA Wildland Fire Air Sensor Challenge: Summary of Performance and Evaluation of Submitted Sensor Pods	<a href="#">Landis et al, 2020 (submitted)</a> ; <a href="#">Science Matters: Challenge Winners</a>
7	AE.7.4.1	Product: Summary and Evaluation of MPAS Retrospective Meteorology Applied to Global Air Quality Modeling	<a href="#">Gilliam et al, 2020 (submitted)</a> ; <a href="#">Advance Air Quality Models Webpage</a>
7	7.4.4	Software tools for the Generation of MPAS Horizontal Meshes to Support Global to Regional Coupled Meteorology and Air Quality Modeling	Combination of Fortran and C++ code and Linux and Python scripts encapsulated into one gzipped tar file currently located on the Atmos compute server: <a href="#">mesh_code</a> <b>[ORD-043249]</b>
9	AE.9.1.7	Product: A Framework for Assessing Trade-Offs in Wildland Fire Management	<a href="#">Hall et al, 2020 (submitted)</a>

## Appointment

---

**From:** Tracy, Tom [Tracy.Tom@epa.gov]  
**Sent:** 4/29/2021 4:31:37 PM  
**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [Ex. 6]; Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6]; Jennifer Hains [Ex. 6]; Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Irivers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com; Amy.scheuer@icf.com; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu  
**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6]; Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]

**Subject:** BOSC AE Subcommittee Mtg

**Attachments:** Untitled Attachment; Untitled Attachment; Untitled Attachment; Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Agenda FINAL\_v2.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; AE Deliverables Table for BOSC 2021.pdf

**Location:** ZOOM - Connection Info Below

**Start:** 10/12/2021 3:00:00 PM

**End:** 10/12/2021 10:00:00 PM

**Show Time As:** Tentative

**Recurrence:** Daily  
every day from 11:00 AM to 6:00 PM

**Required Attendees:** ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara

Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01' [Ex. 6]; Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman, Paul; ljohnson@d.umn.edu

**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner01 [Ex. 6]; Hains, Jennifer (MDH); Frey, Christopher; Rodan, Bruce; Lass, Taylor

[Ex. 6]

Meeting ID: [Ex. 6]

Passcode: [Ex. 6]

## Appointment

---

**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [Ex. 6]; Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6]; jennifer hains [Ex. 6]; Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Irivers@ncsu.edu; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com; Amy.scheuer@icf.com; Paul Gilman [PGilman@covanta.com]; Rohr, Annette [ARohr@epri.com]; ljohnson@d.umn.edu

**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6]; Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Orme-Zavaleta, Jennifer [Orme-Zavaleta.Jennifer@epa.gov]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]

**Start:** 10/13/2021 3:00:00 PM

**End:** 10/13/2021 9:00:00 PM

**Recurrence:** (none)

## Appointment

---

**From:** Tracy, Tom [Tracy.Tom@epa.gov]  
**Sent:** 4/29/2021 4:31:37 PM  
**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [Ex. 6] Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6]; jennifer hains [Ex. 6]; Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; livers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu  
**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6] Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]  
**Subject:** BOSC AE Subcommittee Mtg  
**Attachments:** Untitled Attachment; Untitled Attachment; Untitled Attachment; Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Agenda FINAL\_v2.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; AE Deliverables Table for BOSC 2021.pdf  
**Location:** ZOOM - Connection Info Below  
**Start:** 10/12/2021 3:00:00 PM  
**End:** 10/12/2021 10:00:00 PM  
**Show Time As:** Tentative  
**Recurrence:** Daily  
every day from 11:00 AM to 6:00 PM  
**Required Attendees:** ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01'; [Ex. 6] Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman,Paul ; ljohnson@d.umn.edu  
**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner01 [Ex. 6] Hains, Jennifer (MDH); Frey, Christopher; Rodan, Bruce; Lass, Taylor

[Ex. 6]

Meeting ID: [Ex. 6]

Passcode: [Ex. 6]

## Appointment

---

**From:** Tracy, Tom [Tracy.Tom@epa.gov]  
**Sent:** 4/29/2021 4:31:37 PM  
**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [s[Ex. 6] Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6] jennifer hains [Ex. 6]; Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Irivers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu  
**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6] Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Orme-Zavaleta, Jennifer [Orme-Zavaleta.Jennifer@epa.gov]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]  
**Subject:** BOSC AE Subcommittee Mtg  
**Location:** Connection Information Coming Soon  
**Start:** 10/12/2021 3:00:00 PM  
**End:** 10/12/2021 9:00:00 PM  
**Show Time As:** Busy  
**Recurrence:** Daily  
every day from 11:00 AM to 5:00 PM  
**Required Attendees:** ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01[Ex. 6]'; Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman, Paul; ljohnson@d.umn.edu  
**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner01[Ex. 6] Hains, Jennifer (MDH); Orme-Zavaleta, Jennifer; Frey, Christopher; Rodan, Bruce; Lass, Taylor

-----Original Appointment-----

**From:** Tracy, Tom <Tracy.Tom@epa.gov>  
**Sent:** Friday, April 9, 2021 1:02 PM  
**To:** Tracy, Tom; ca.geffen@pnnl.gov; Sandy Smith; Viney P Aneja; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; jennifer hains; Keslar, Cara; mtkleinm@uci.edu; Myron Mitchell; Irivers@ncsu.edu; Rohr, Annette; Constance Senior; Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; canden.byrd@icf.com; Scheuer, Amy; Paul Gilman; ljohnson@d.umn.edu  
**Cc:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; Art Werner; Hains, Jennifer (MDH)  
**Subject:** BOSC AE Subcommittee Mtg  
**When:** Occurs every day effective 10/12/2021 until 10/14/2021 from 11:00 AM to 5:00 PM (UTC-05:00) Eastern Time (US & Canada).  
**Where:** Connection Information Coming Soon

## Appointment

---

**From:** Tracy, Tom [Tracy.Tom@epa.gov]  
**Sent:** 4/29/2021 4:31:37 PM  
**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [Ex. 6]; Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6]; jennifer hains [Ex. 6]; Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; livers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu  
**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6]; Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]  
**Subject:** BOSC AE Subcommittee Mtg  
**Attachments:** Untitled Attachment; Untitled Attachment; Untitled Attachment; Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Agenda FINAL\_v2.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; AE Deliverables Table for BOSC 2021.pdf; Untitled Attachment  
**Location:** ZOOM - Connection Info Below  
**Start:** 10/12/2021 3:00:00 PM  
**End:** 10/12/2021 10:00:00 PM  
**Show Time As:** Tentative  
**Recurrence:** Daily  
every day from 11:00 AM to 6:00 PM  
**Required Attendees:** ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01' [Ex. 6]; Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman,Paul ; ljohnson@d.umn.edu  
**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner01 [Ex. 6]; Hains, Jennifer (MDH); Frey, Christopher; Rodan, Bruce; Lass, Taylor

[Ex. 6]

Meeting ID: [Ex. 6]

Passcode [Ex. 6]

## Appointment

---

**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [Ex. 6] Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6] Jennifer Hains [Ex. 6] Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Irivers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu

**CC:** Doa, Maria [Doa.Maria@epa.gov]; Ross, Mary [Ross.Mary@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6] Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]

**Attachments:** Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Agenda FINAL\_v2.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; AE Deliverables Table for BOSC 2021.pdf

**Start:** 10/14/2021 3:00:00 PM  
**End:** 10/14/2021 10:00:00 PM

**Recurrence:** (none)

## Appointment

---

**From:** Tracy, Tom [Tracy.Tom@epa.gov]  
**Sent:** 4/29/2021 4:31:37 PM  
**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [Ex. 6] Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6] Jennifer Hains [Ex. 6]; Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; lrivers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu  
**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6] Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]  
**Subject:** BOSC AE Subcommittee Mtg  
**Attachments:** Untitled Attachment; Untitled Attachment; Untitled Attachment; Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Agenda FINAL\_v2.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; AE Deliverables Table for BOSC 2021.pdf; Untitled Attachment; Untitled Attachment  
**Location:** ZOOM - Connection Info Below  
**Start:** 10/12/2021 3:00:00 PM  
**End:** 10/12/2021 10:00:00 PM  
**Show Time As:** Tentative  
**Recurrence:** Daily  
every day from 11:00 AM to 6:00 PM  
**Required Attendees:** ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01'; [Ex. 6] Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman, Paul; ljohnson@d.umn.edu  
**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner01 [Ex. 6] Hains, Jennifer (MDH); Frey, Christopher; Rodan, Bruce; Lass, Taylor

[Ex. 6]

Meeting ID: [Ex. 6]

Passcode: [Ex. 6]

## Appointment

---

**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [Ex. 6] Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6] jennifer hains [Ex. 6] Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Irivers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu; Hunt, Sherri [Hunt.Sherri@epa.gov]

**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6] Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]; A-E Team [AE\_Team@epa.gov]; Chung, Serena [chung.serena@epa.gov]; Miller, Andy [Miller.Andy@epa.gov]; Lazzarino, Elisa [lazzarino.elisa@epa.gov]; Vu, Chau [Vu.Chau@epa.gov]; Elleman, Robert [Elleman.Robert@epa.gov]; Hill, Annelise [Hill.Annelise@epa.gov]; Shatas, Angie [Shatas.Angie@epa.gov]; Hassett-Sipple, Beth [Hassett-Sipple.Beth@epa.gov]; Watkins, Tim [Watkins.Tim@epa.gov]; Gilliland, Alice [Gilliland.Alice@epa.gov]; Hagler, Gayle [Hagler.Gayle@epa.gov]; Holt, Kay [Holt.Kay@epa.gov]; Phelps, Lara [Phelps.Lara@epa.gov]; Dodder, Rebecca [Dodder.Rebecca@epa.gov]; Pierce, Tom [Pierce.Tom@epa.gov]; Yelverton, Tiffany [Yelverton.Tiffany@epa.gov]; Benner, Tim [Benner.Tim@epa.gov]; Tran, Lynn [Tran.Lynn@epa.gov]; Stearns, Bailey [stearns.bailey@epa.gov]; Burden, Susan [Burden.Susan@epa.gov]; Brown, Ann [Brown.Ann@epa.gov]; Clark, Christopher [Clark.Christopher@epa.gov]; Bierwagen, Britta [Bierwagen.Britta@epa.gov]; Vette, Alan [Vette.Alan@epa.gov]

**Attachments:** Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Agenda FINAL\_v2.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; AE Deliverables Table for BOSC 2021.pdf

**Start:** 10/12/2021 3:00:00 PM  
**End:** 10/12/2021 10:00:00 PM

**Recurrence:** (none)

**Required Attendees:** Tracy, Tom; ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01' [Ex. 6] Hubbell, Bryan; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman, Paul; ljohnson@d.umn.edu; Hunt, Sherri

**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner01 [Ex. 6] Hains, Jennifer (MDH); Frey, Christopher; Rodan, Bruce; Lass, Taylor; A-E Team; Chung, Serena; Miller, Andy; Lazzarino, Elisa; Vu, Chau; Elleman, Robert; Hill, Annelise; Shatas, Angie; Hassett-Sipple, Beth; Clark, Christopher; Bierwagen, Britta; Watkins, Tim; Gilliland, Alice; Hagler, Gayle; Holt, Kay; Vette, Alan; Phelps, Lara; Dodder, Rebecca; Pierce, Tom; Yelverton, Tiffany; Benner, Tim; Tran, Lynn; Burden, Susan; Brown, Ann

## Appointment

**From:** Tracy, Tom [Tracy.Tom@epa.gov]  
**Sent:** 4/29/2021 4:31:37 PM  
**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [Ex. 6]; Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6]; jennifer hains [Ex. 6]; Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Irlivers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu  
**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6]; Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]; ACE Team [ACE\_Team@epa.gov]; Chung, Serena [chung.serena@epa.gov]; Miller, Andy [Miller.Andy@epa.gov]; Lazzarino, Elisa [lazzarino.elisa@epa.gov]; Vu, Chau [Vu.Chau@epa.gov]; Elleman, Robert [Elleman.Robert@epa.gov]; Hill, Annelise [Hill.Annelise@epa.gov]; Shatas, Angie [Shatas.Angie@epa.gov]; Hassett-Sipple, Beth [Hassett-Sipple.Beth@epa.gov]; Clark, Christopher [Clark.Christopher@epa.gov]; Bierwagen, Britta [Bierwagen.Britta@epa.gov]; Watkins, Tim [Watkins.Tim@epa.gov]; Gilliland, Alice [Gilliland.Alice@epa.gov]; Hagler, Gayle [Hagler.Gayle@epa.gov]; Holt, Kay [Holt.Kay@epa.gov]; Vette, Alan [Vette.Alan@epa.gov]; Phelps, Lara [Phelps.Lara@epa.gov]; Dodder, Rebecca [Dodder.Rebecca@epa.gov]; Pierce, Tom [Pierce.Tom@epa.gov]; Yelverton, Tiffany [Yelverton.Tiffany@epa.gov]; Benner, Tim [Benner.Tim@epa.gov]; Tran, Lynn [Tran.Lynn@epa.gov]; Brown, Ann [Brown.Ann@epa.gov]; Stearns, Bailey [stearns.bailey@epa.gov]; Winner, Darrell [Winner.Darrell@epa.gov]; Beedlow, Peter [Beedlow.Peter@epa.gov]  
**Subject:** BOSC AE Subcommittee Mtg  
**Attachments:** Untitled Attachment; Untitled Attachment; Untitled Attachment; Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Agenda FINAL\_v2.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; AE Deliverables Table for BOSC 2021.pdf; Untitled Attachment; Untitled Attachment  
**Location:** ZOOM - Connection Info Below  
**Start:** 10/12/2021 3:00:00 PM  
**End:** 10/12/2021 10:00:00 PM  
**Show Time As:** Tentative  
**Recurrence:** Daily  
every day from 11:00 AM to 6:00 PM  
**Required Attendees:** Tracy, Tom; ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01'; [Ex. 6]; Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman,Paul ; ljohnson@d.umn.edu  
**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner01 [Ex. 6]; Hains, Jennifer (MDH); Frey, Christopher; Rodan, Bruce; Lass, Taylor; A-E Team; Chung, Serena; Miller, Andy; Lazzarino, Elisa; Vu, Chau; Elleman, Robert; Hill, Annelise; Shatas, Angie; Hassett-Sipple, Beth; Clark, Christopher; Bierwagen, Britta; Watkins, Tim; Gilliland, Alice; Hagler, Gayle; Holt, Kay; Vette, Alan; Phelps, Lara; Dodder, Rebecca; Pierce, Tom; Yelverton, Tiffany; Benner, Tim; Tran, Lynn; Brown, Ann; Stearns, Bailey; Winner, Darrell; Beedlow, Peter

Ex. 6

Meeting ID: Ex. 6

Passcode: Ex. 6

## Appointment

---

**From:** Tracy, Tom [Tracy.Tom@epa.gov]  
**Sent:** 4/29/2021 4:31:37 PM  
**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [sandysmithaust@Ex. 6]; Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [croes.bart@Ex. 6]; Jennifer Hains [hainsjc@Ex. 6]; Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Irivers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu  
**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [artwerner01@Ex. 6]; Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Orme-Zavaleta, Jennifer [Orme-Zavaleta.Jennifer@epa.gov]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]  
**Subject:** BOSC AE Subcommittee Mtg  
**Attachments:** Untitled Attachment  
**Location:** Connection Information Coming Soon  
  
**Start:** 10/12/2021 3:00:00 PM  
**End:** 10/12/2021 9:00:00 PM  
**Show Time As:** Busy  
  
**Recurrence:** Daily  
every day from 11:00 AM to 5:00 PM  
**Required Attendees:** ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01@Ex. 6'; Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman, Paul; ljohnson@d.umn.edu  
**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner01@Ex. 6; Hains, Jennifer (MDH); Orme-Zavaleta, Jennifer; Frey, Christopher; Rodan, Bruce; Lass, Taylor

-----Original Appointment-----

**From:** Tracy, Tom <Tracy.Tom@epa.gov>  
**Sent:** Friday, April 9, 2021 1:02 PM  
**To:** Tracy, Tom; ca.geffen@pnnl.gov; Sandy Smith; Viney P Aneja; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; jennifer hains; Keslar, Cara; mtkleinm@uci.edu; Myron Mitchell; Irivers@ncsu.edu; Rohr, Annette; Constance Senior; Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; canden.byrd@icf.com; Scheuer, Amy; Paul Gilman; ljohnson@d.umn.edu  
**Cc:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; Art Werner; Hains, Jennifer (MDH)  
**Subject:** BOSC AE Subcommittee Mtg  
**When:** Occurs every day effective 10/12/2021 until 10/14/2021 from 11:00 AM to 5:00 PM (UTC-05:00) Eastern Time (US & Canada).  
**Where:** Connection Information Coming Soon

## Appointment

**From:** Tracy, Tom [Tracy.Tom@epa.gov]  
**Sent:** 4/29/2021 4:31:37 PM  
**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [Ex. 6]; Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6]; jennifer hains [Ex. 6]; Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Irlivers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu  
**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6]; Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]; ACE Team [ACE\_Team@epa.gov]; Chung, Serena [chung.serena@epa.gov]; Miller, Andy [Miller.Andy@epa.gov]; Lazzarino, Elisa [lazzarino.elisa@epa.gov]; Vu, Chau [Vu.Chau@epa.gov]; Elleman, Robert [Elleman.Robert@epa.gov]; Hill, Annelise [Hill.Annelise@epa.gov]; Shatas, Angie [Shatas.Angie@epa.gov]; Hassett-Sipple, Beth [Hassett-Sipple.Beth@epa.gov]; Clark, Christopher [Clark.Christopher@epa.gov]; Bierwagen, Britta [Bierwagen.Britta@epa.gov]; Watkins, Tim [Watkins.Tim@epa.gov]; Gilliland, Alice [Gilliland.Alice@epa.gov]; Hagler, Gayle [Hagler.Gayle@epa.gov]; Holt, Kay [Holt.Kay@epa.gov]; Vette, Alan [Vette.Alan@epa.gov]; Phelps, Lara [Phelps.Lara@epa.gov]; Dodder, Rebecca [Dodder.Rebecca@epa.gov]; Pierce, Tom [Pierce.Tom@epa.gov]; Yelverton, Tiffany [Yelverton.Tiffany@epa.gov]; Benner, Tim [Benner.Tim@epa.gov]; Tran, Lynn [Tran.Lynn@epa.gov]; Brown, Ann [Brown.Ann@epa.gov]; Stearns, Bailey [stearns.bailey@epa.gov]; Winner, Darrell [Winner.Darrell@epa.gov]; Beedlow, Peter [Beedlow.Peter@epa.gov]  
**Subject:** BOSC AE Subcommittee Mtg  
**Attachments:** Untitled Attachment; Untitled Attachment; Untitled Attachment; Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Agenda FINAL\_v2.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; AE Deliverables Table for BOSC 2021.pdf; Untitled Attachment; Untitled Attachment; Untitled Attachment  
**Location:** ZOOM - Connection Info Below  
**Start:** 10/12/2021 3:00:00 PM  
**End:** 10/12/2021 10:00:00 PM  
**Show Time As:** Tentative  
**Recurrence:** Daily  
every day from 11:00 AM to 6:00 PM  
**Required Attendees:** Tracy, Tom; ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01' [Ex. 6]; Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman, Paul; ljohnson@d.umn.edu  
**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner01 [Ex. 6]; Hains, Jennifer (MDH); Frey, Christopher; Rodan, Bruce; Lass, Taylor; A-E Team; Chung, Serena; Miller, Andy; Lazzarino, Elisa; Vu, Chau; Elleman, Robert; Hill, Annelise; Shatas, Angie; Hassett-Sipple, Beth; Clark, Christopher; Bierwagen, Britta; Watkins, Tim; Gilliland, Alice; Hagler, Gayle; Holt, Kay; Vette, Alan; Phelps, Lara; Dodder, Rebecca; Pierce, Tom; Yelverton, Tiffany; Benner, Tim; Tran, Lynn; Brown, Ann; Stearns, Bailey; Winner, Darrell; Beedlow, Peter

Ex. 6

Meeting ID: Ex. 6

Passcode: Ex. 6

## Appointment

---

**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [croes.bart@Ex. 6]; Jennifer hains [Ex. 6] Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Iivers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu; Hunt, Sherri [Hunt.Sherri@epa.gov]; Sandy Smith [Ex. 6]

**CC:** Doa, Maria [Doa.Maria@epa.gov]; Ross, Mary [Ross.Mary@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6] Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]; ACE Team [ACE\_Team@epa.gov]; Chung, Serena [chung.serena@epa.gov]; Miller, Andy [Miller.Andy@epa.gov]; Lazzarino, Elisa [lazzarino.elisa@epa.gov]; Vu, Chau [Vu.Chau@epa.gov]; Elleman, Robert [Elleman.Robert@epa.gov]; Hill, Annelise [Hill.Annelise@epa.gov]; Shatas, Angie [Shatas.Angie@epa.gov]; Bierwagen, Britta [Bierwagen.Britta@epa.gov]; Watkins, Tim [Watkins.Tim@epa.gov]; Gilliland, Alice [Gilliland.Alice@epa.gov]; Hagler, Gayle [Hagler.Gayle@epa.gov]; Holt, Kay [Holt.Kay@epa.gov]; Phelps, Lara [Phelps.Lara@epa.gov]; Pierce, Tom [Pierce.Tom@epa.gov]; Yelverton, Tiffany [Yelverton.Tiffany@epa.gov]; Benner, Tim [Benner.Tim@epa.gov]; Tran, Lynn [Tran.Lynn@epa.gov]; Stearns, Bailey [stearns.bailey@epa.gov]; Beedlow, Peter [Beedlow.Peter@epa.gov]; Brown, Ann [Brown.Ann@epa.gov]; Clark, Christopher [Clark.Christopher@epa.gov]; Vette, Alan [Vette.Alan@epa.gov]; Winner, Darrell [Winner.Darrell@epa.gov]; Dodder, Rebecca [Dodder.Rebecca@epa.gov]; Hassett-Sipple, Beth [Hassett-Sipple.Beth@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]

**Attachments:** Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Agenda FINAL\_v2.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; AE Deliverables Table for BOSC 2021.pdf

**Start:** 10/14/2021 3:00:00 PM  
**End:** 10/14/2021 10:00:00 PM

**Recurrence:** (none)

**Required Attendees:** Tracy, Tom; ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01 [Ex. 6]'; Hubbell, Bryan; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman, Paul; ljohnson@d.umn.edu; Hunt, Sherri

**Optional Attendees:** Ross, Mary; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner01 [Ex. 6] Hains, Jennifer (MDH); Frey, Christopher; Rodan, Bruce; Lass, Taylor; A-E Team; Chung, Serena; Miller, Andy; Lazzarino, Elisa; Vu, Chau; Elleman, Robert; Hill, Annelise; Shatas, Angie; Hassett-Sipple, Beth; Bierwagen, Britta; Watkins, Tim; Gilliland, Alice; Hagler, Gayle; Holt, Kay; Phelps, Lara; Dodder, Rebecca; Pierce, Tom; Yelverton, Tiffany; Benner, Tim; Tran, Lynn; Stearns, Bailey; Doa, Maria; Brown, Ann; Clark, Christopher; Vette, Alan; Winner, Darrell

## Appointment

---

**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6] jennifer hains [Ex. 6] Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syrr.edu]; Irvivers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu; Hunt, Sherri [Hunt.Sherri@epa.gov]; Sandy Smith [Ex. 6]

**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6] Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]; ACE Team [ACE\_Team@epa.gov]; Chung, Serena [chung.serena@epa.gov]; Miller, Andy [Miller.Andy@epa.gov]; Lazzarino, Elisa [lazzarino.elisa@epa.gov]; Vu, Chau [Vu.Chau@epa.gov]; Elleman, Robert [Elleman.Robert@epa.gov]; Hill, Annelise [Hill.Annelise@epa.gov]; Shatas, Angie [Shatas.Angie@epa.gov]; Hassett-Sipple, Beth [Hassett-Sipple.Beth@epa.gov]; Watkins, Tim [Watkins.Tim@epa.gov]; Gilliland, Alice [Gilliland.Alice@epa.gov]; Hagler, Gayle [Hagler.Gayle@epa.gov]; Holt, Kay [Holt.Kay@epa.gov]; Phelps, Lara [Phelps.Lara@epa.gov]; Pierce, Tom [Pierce.Tom@epa.gov]; Yelverton, Tiffany [Yelverton.Tiffany@epa.gov]; Benner, Tim [Benner.Tim@epa.gov]; Tran, Lynn [Tran.Lynn@epa.gov]; Stearns, Bailey [stearns.bailey@epa.gov]; Beedlow, Peter [Beedlow.Peter@epa.gov]; Burden, Susan [Burden.Susan@epa.gov]; Brown, Ann [Brown.Ann@epa.gov]; Clark, Christopher [Clark.Christopher@epa.gov]; Bierwagen, Britta [Bierwagen.Britta@epa.gov]; Vette, Alan [Vette.Alan@epa.gov]; Winner, Darrell [Winner.Darrell@epa.gov]; Dodder, Rebecca [Dodder.Rebecca@epa.gov]

**Attachments:** Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Agenda FINAL\_v2.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; AE Deliverables Table for BOSC 2021.pdf

**Start:** 10/12/2021 3:00:00 PM  
**End:** 10/12/2021 10:00:00 PM

**Recurrence:** (none)

**Required Attendees:** Tracy, Tom; ca.geffen@pnnl.gov; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01 [Ex. 6] Hubbell, Bryan; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman, Paul ; ljohnson@d.umn.edu; Hunt, Sherri; Sandy Smith

**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner01 [Ex. 6] Hains, Jennifer (MDH); Frey, Christopher; Rodan, Bruce; Lass, Taylor; A-E Team; Chung, Serena; Miller, Andy; Lazzarino, Elisa; Vu, Chau; Elleman, Robert; Hill, Annelise; Shatas, Angie; Hassett-Sipple, Beth; Watkins, Tim; Gilliland, Alice; Hagler, Gayle; Holt, Kay; Phelps, Lara; Pierce, Tom; Yelverton, Tiffany; Benner, Tim; Tran, Lynn; Stearns, Bailey; Burden, Susan; Brown, Ann; Clark, Christopher; Bierwagen, Britta; Vette, Alan; Winner, Darrell; Dodder, Rebecca; Beedlow, Peter

## Appointment

---

**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6]; Jennifer hains [Ex. 6] Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Iivers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu; Hunt, Sherri [Hunt.Sherri@epa.gov]; Sandy Smith [Ex. 6]

**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6]; Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]; ACE Team [ACE\_Team@epa.gov]; Chung, Serena [chung.serena@epa.gov]; Miller, Andy [Miller.Andy@epa.gov]; Lazzarino, Elisa [lazzarino.elisa@epa.gov]; Vu, Chau [Vu.Chau@epa.gov]; Elleman, Robert [Elleman.Robert@epa.gov]; Hill, Annelise [Hill.Annelise@epa.gov]; Shatas, Angie [Shatas.Angie@epa.gov]; Hassett-Sipple, Beth [Hassett-Sipple.Beth@epa.gov]; Watkins, Tim [Watkins.Tim@epa.gov]; Gilliland, Alice [Gilliland.Alice@epa.gov]; Hagler, Gayle [Hagler.Gayle@epa.gov]; Holt, Kay [Holt.Kay@epa.gov]; Phelps, Lara [Phelps.Lara@epa.gov]; Pierce, Tom [Pierce.Tom@epa.gov]; Yelverton, Tiffany [Yelverton.Tiffany@epa.gov]; Benner, Tim [Benner.Tim@epa.gov]; Tran, Lynn [Tran.Lynn@epa.gov]; Stearns, Bailey [stearns.bailey@epa.gov]; Brown, Ann [Brown.Ann@epa.gov]; Clark, Christopher [Clark.Christopher@epa.gov]; Bierwagen, Britta [Bierwagen.Britta@epa.gov]; Vette, Alan [Vette.Alan@epa.gov]; Winner, Darrell [Winner.Darrell@epa.gov]; Dodder, Rebecca [Dodder.Rebecca@epa.gov]; Beedlow, Peter [Beedlow.Peter@epa.gov]

**Attachments:** Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Agenda FINAL\_v2.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; AE Deliverables Table for BOSC 2021.pdf

**Start:** 10/13/2021 3:00:00 PM  
**End:** 10/13/2021 10:00:00 PM

**Recurrence:** (none)

**Required Attendees:** Tracy, Tom; ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01[Ex. 6]'; Hubbell, Bryan; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman, Paul; ljohnson@d.umn.edu; Hunt, Sherri

**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner0[Ex. 6]; Hains, Jennifer (MDH); Frey, Christopher; Rodan, Bruce; Lass, Taylor; A-E Team; Chung, Serena; Miller, Andy; Lazzarino, Elisa; Vu, Chau; Elleman, Robert; Hill, Annelise; Shatas, Angie; Hassett-Sipple, Beth; Clark, Christopher; Bierwagen, Britta; Watkins, Tim; Gilliland, Alice; Hagler, Gayle; Holt, Kay; Vette, Alan; Phelps, Lara; Dodder, Rebecca; Pierce, Tom; Yelverton, Tiffany; Benner, Tim; Tran, Lynn; Brown, Ann

## Appointment

---

**From:** Tracy, Tom [Tracy.Tom@epa.gov]  
**Sent:** 4/29/2021 4:31:37 PM  
**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [Ex. 6]; Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6]; jennifer hains [Ex. 6]; Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Irlivers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu  
**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6]; Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]; ACE Team [ACE\_Team@epa.gov]; Chung, Serena [chung.serena@epa.gov]; Miller, Andy [Miller.Andy@epa.gov]; Lazzarino, Elisa [lazzarino.elisa@epa.gov]; Vu, Chau [Vu.Chau@epa.gov]; Elleman, Robert [Elleman.Robert@epa.gov]; Hill, Annelise [Hill.Annelise@epa.gov]; Shatas, Angie [Shatas.Angie@epa.gov]; Hassett-Sipple, Beth [Hassett-Sipple.Beth@epa.gov]; Clark, Christopher [Clark.Christopher@epa.gov]; Bierwagen, Britta [Bierwagen.Britta@epa.gov]; Watkins, Tim [Watkins.Tim@epa.gov]; Gilliland, Alice [Gilliland.Alice@epa.gov]; Hagler, Gayle [Hagler.Gayle@epa.gov]; Holt, Kay [Holt.Kay@epa.gov]; Vette, Alan [Vette.Alan@epa.gov]; Phelps, Lara [Phelps.Lara@epa.gov]; Dodder, Rebecca [Dodder.Rebecca@epa.gov]; Pierce, Tom [Pierce.Tom@epa.gov]; Yelverton, Tiffany [Yelverton.Tiffany@epa.gov]; Benner, Tim [Benner.Tim@epa.gov]; Tran, Lynn [Tran.Lynn@epa.gov]; Brown, Ann [Brown.Ann@epa.gov]; Stearns, Bailey [stearns.bailey@epa.gov]; Winner, Darrell [Winner.Darrell@epa.gov]; Beedlow, Peter [Beedlow.Peter@epa.gov]; Sams, Elizabeth [Sams.Elizabeth@epa.gov]  
**Subject:** BOSC AE Subcommittee Mtg  
**Attachments:** Untitled Attachment; Untitled Attachment; Untitled Attachment; Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Agenda FINAL\_v2.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; AE Deliverables Table for BOSC 2021.pdf; Untitled Attachment; Untitled Attachment; Untitled Attachment  
**Location:** ZOOM - Connection Info Below  
**Start:** 10/12/2021 3:00:00 PM  
**End:** 10/12/2021 10:00:00 PM  
**Show Time As:** Tentative  
**Recurrence:** Daily  
every day from 11:00 AM to 6:00 PM  
**Required Attendees:** Tracy, Tom; ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01'; [Ex. 6]; Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman,Paul ; ljohnson@d.umn.edu  
**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner01; [Ex. 6]; Hains, Jennifer (MDH); Frey, Christopher; Rodan, Bruce; Lass, Taylor; A-E Team; Chung, Serena; Miller, Andy; Lazzarino, Elisa; Vu, Chau; Elleman, Robert; Hill, Annelise; Shatas, Angie; Hassett-Sipple, Beth; Clark, Christopher; Bierwagen, Britta; Watkins, Tim; Gilliland, Alice; Hagler, Gayle; Holt, Kay; Vette, Alan; Phelps, Lara; Dodder, Rebecca; Pierce, Tom; Yelverton, Tiffany; Benner, Tim; Tran, Lynn; Brown, Ann; Stearns, Bailey; Winner, Darrell; Beedlow, Peter; Sams, Elizabeth

Ex. 6

Meeting ID: [Ex. 6]  
Passcode: [Ex. 6]

## Appointment

---

**From:** Tracy, Tom [Tracy.Tom@epa.gov]  
**Sent:** 4/29/2021 4:31:37 PM  
**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [sandysmithaustx@Ex. 6]; Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [croes.bart@Ex. 6]; jennifer hains [hainsjc@Ex. 6]; Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Irivers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu  
**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [artwerner01@Ex. 6]; Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Orme-Zavaleta, Jennifer [Orme-Zavaleta.Jennifer@epa.gov]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]  
**Subject:** BOSC AE Subcommittee Mtg  
**Attachments:** Untitled Attachment; Untitled Attachment  
**Location:** Connection Information Coming Soon  
  
**Start:** 10/12/2021 3:00:00 PM  
**End:** 10/12/2021 9:00:00 PM  
**Show Time As:** Busy  
  
**Recurrence:** Daily  
every day from 11:00 AM to 5:00 PM  
**Required Attendees:** ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01@Ex. 6'; Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman, Paul; ljohnson@d.umn.edu  
**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner01@Ex. 6; Hains, Jennifer (MDH); Orme-Zavaleta, Jennifer; Frey, Christopher; Rodan, Bruce; Lass, Taylor

-----Original Appointment-----

**From:** Tracy, Tom <Tracy.Tom@epa.gov>  
**Sent:** Friday, April 9, 2021 1:02 PM  
**To:** Tracy, Tom; ca.geffen@pnnl.gov; Sandy Smith; Viney P Aneja; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; jennifer hains; Keslar, Cara; mtkleinm@uci.edu; Myron Mitchell; Irivers@ncsu.edu; Rohr, Annette; Constance Senior; Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; canden.byrd@icf.com; Scheuer, Amy; Paul Gilman; ljohnson@d.umn.edu  
**Cc:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; Art Werner; Hains, Jennifer (MDH)  
**Subject:** BOSC AE Subcommittee Mtg  
**When:** Occurs every day effective 10/12/2021 until 10/14/2021 from 11:00 AM to 5:00 PM (UTC-05:00) Eastern Time (US & Canada).  
**Where:** Connection Information Coming Soon

## Appointment

**From:** Tracy, Tom [Tracy.Tom@epa.gov]  
**Sent:** 4/29/2021 4:31:37 PM  
**To:** Tracy, Tom [Tracy.Tom@epa.gov]; ca.geffen@pnnl.gov; Sandy Smith [Ex. 6] Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6] jennifer hains [Ex. 6] Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Irivers@ncsu.edu; Rohr, Annette [arohr@epri.com]; Constance Senior [connie@conniesenior.com]; 'artwerner0[Ex. 6] Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com; Amy.scheuer@icf.com; Gilman,Paul [PGilman@covanta.com]; ljohnson@d.umn.edu  
**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6] Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]; ACE Team [ACE\_Team@epa.gov]; Chung, Serena [chung.serena@epa.gov]; Miller, Andy [Miller.Andy@epa.gov]; Lazzarino, Elisa [lazzarino.elisa@epa.gov]; Vu, Chau [Vu.Chau@epa.gov]; Elleman, Robert [Elleman.Robert@epa.gov]; Hill, Annelise [Hill.Annelise@epa.gov]; Shatas, Angie [Shatas.Angie@epa.gov]; Hassett-Sipple, Beth [Hassett-Sipple.Beth@epa.gov]; Clark, Christopher [Clark.Christopher@epa.gov]; Bierwagen, Britta [Bierwagen.Britta@epa.gov]; Watkins, Tim [Watkins.Tim@epa.gov]; Gilliland, Alice [Gilliland.Alice@epa.gov]; Hagler, Gayle [Hagler.Gayle@epa.gov]; Holt, Kay [Holt.Kay@epa.gov]; Vette, Alan [Vette.Alan@epa.gov]; Phelps, Lara [Phelps.Lara@epa.gov]; Dodder, Rebecca [Dodder.Rebecca@epa.gov]; Pierce, Tom [Pierce.Tom@epa.gov]; Yelverton, Tiffany [Yelverton.Tiffany@epa.gov]; Benner, Tim [Benner.Tim@epa.gov]; Tran, Lynn [Tran.Lynn@epa.gov]; Brown, Ann [Brown.Ann@epa.gov]; Stearns, Bailey [stearns.bailey@epa.gov]; Winner, Darrell [Winner.Darrell@epa.gov]; Beedlow, Peter [Beedlow.Peter@epa.gov]; Sams, Elizabeth [Sams.Elizabeth@epa.gov]  
**Subject:** BOSC AE Subcommittee Mtg  
**Attachments:** Untitled Attachment; Untitled Attachment; Untitled Attachment; Untitled Attachment; Untitled Attachment; Untitled Attachment; Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; ACE Deliverables Table for BOSC 2021.pdf; AE BOSC 20211012 Agenda.pdf  
**Location:** ZOOM - Connection Info Below  
**Start:** 10/12/2021 3:00:00 PM  
**End:** 10/12/2021 10:00:00 PM  
**Show Time As:** Tentative  
**Recurrence:** Daily  
every day from 11:00 AM to 6:00 PM  
**Required Attendees:** ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner0[Ex. 6] Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman,Paul ; ljohnson@d.umn.edu  
**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner0[Ex. 6] Hains, Jennifer (MDH); Frey, Christopher; Rodan, Bruce; Lass, Taylor; A-E Team; Chung, Serena; Miller, Andy; Lazzarino, Elisa; Vu, Chau; Elleman, Robert; Hill, Annelise; Shatas, Angie; Hassett-Sipple, Beth; Clark, Christopher; Bierwagen, Britta; Watkins, Tim; Gilliland, Alice; Hagler, Gayle; Holt, Kay; Vette, Alan; Phelps, Lara; Dodder, Rebecca; Pierce, Tom; Yelverton, Tiffany; Benner, Tim; Tran, Lynn; Brown, Ann; Stearns, Bailey; Winner, Darrell; Beedlow, Peter; Sams, Elizabeth

Ex. 6

Meeting ID [Ex. 6]

Passcode: [Ex. 6]

## Appointment

**To:** Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; jennifer hains [Ex. 6] Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Iivers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu; Hunt, Sherri [Hunt.Sherri@epa.gov]; Sandy Smith [Ex. 6] ca.geffen@pnnl.gov; Tracy, Tom [Tracy.Tom@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Sandy Smith [Ex. 6] ca.geffen@pnnl.gov; Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6] jennifer hains [Ex. 6] Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Iivers@ncsu.edu; Rohr, Annette [arohr@epri.com]; Constance Senior [connie@conniesenior.com]; [Ex. 6] Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com; Amy.scheuer@icf.com; Gilman,Paul [PGilman@covanta.com]; ljohnson@d.umn.edu

**CC:** Doa, Maria [Doa.Maria@epa.gov]; Ross, Mary [Ross.Mary@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6] Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]; ACE Team [ACE\_Team@epa.gov]; Chung, Serena [chung.serena@epa.gov]; Miller, Andy [Miller.Andy@epa.gov]; Lazzarino, Elisa [lazzarino.elisa@epa.gov]; Vu, Chau [Vu.Chau@epa.gov]; Elleman, Robert [Elleman.Robert@epa.gov]; Hill, Annelise [Hill.Annelise@epa.gov]; Shatas, Angie [Shatas.Angie@epa.gov]; Bierwagen, Britta [Bierwagen.Britta@epa.gov]; Watkins, Tim [Watkins.Tim@epa.gov]; Gilliland, Alice [Gilliland.Alice@epa.gov]; Hagler, Gayle [Hagler.Gayle@epa.gov]; Holt, Kay [Holt.Kay@epa.gov]; Phelps, Lara [Phelps.Lara@epa.gov]; Pierce, Tom [Pierce.Tom@epa.gov]; Yelverton, Tiffany [Yelverton.Tiffany@epa.gov]; Benner, Tim [Benner.Tim@epa.gov]; Tran, Lynn [Tran.Lynn@epa.gov]; Stearns, Bailey [stearns.bailey@epa.gov]; Beedlow, Peter [Beedlow.Peter@epa.gov]; Brown, Ann [Brown.Ann@epa.gov]; Clark, Christopher [Clark.Christopher@epa.gov]; Vette, Alan [Vette.Alan@epa.gov]; Winner, Darrell [Winner.Darrell@epa.gov]; Dodder, Rebecca [Dodder.Rebecca@epa.gov]; Hassett-Sipple, Beth [Hassett-Sipple.Beth@epa.gov]; Sams, Elizabeth [Sams.Elizabeth@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Brown, Ann [Brown.Ann@epa.gov]; Clark, Christopher [Clark.Christopher@epa.gov]; Vette, Alan [Vette.Alan@epa.gov]; Winner, Darrell [Winner.Darrell@epa.gov]; Dodder, Rebecca [Dodder.Rebecca@epa.gov]; Hassett-Sipple, Beth [Hassett-Sipple.Beth@epa.gov]; Sams, Elizabeth [Sams.Elizabeth@epa.gov]; Appel, Keith Wyat [Appel.Wyat@epa.gov]; Ross, Mary [Ross.Mary@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6] Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]; ACE Team [ACE\_Team@epa.gov]; Chung, Serena [chung.serena@epa.gov]; Miller, Andy [Miller.Andy@epa.gov]; Lazzarino, Elisa [lazzarino.elisa@epa.gov]; Vu, Chau [Vu.Chau@epa.gov]; Elleman, Robert [Elleman.Robert@epa.gov]; Hill, Annelise [Hill.Annelise@epa.gov]; Shatas, Angie [Shatas.Angie@epa.gov]; Bierwagen, Britta [Bierwagen.Britta@epa.gov]; Watkins, Tim [Watkins.Tim@epa.gov]; Gilliland, Alice [Gilliland.Alice@epa.gov]; Hagler, Gayle [Hagler.Gayle@epa.gov]; Holt, Kay [Holt.Kay@epa.gov]; Phelps, Lara [Phelps.Lara@epa.gov]; Pierce, Tom [Pierce.Tom@epa.gov]; Yelverton, Tiffany [Yelverton.Tiffany@epa.gov]; Benner, Tim [Benner.Tim@epa.gov]; Tran, Lynn [Tran.Lynn@epa.gov]; Stearns, Bailey [stearns.bailey@epa.gov]; Beedlow, Peter [Beedlow.Peter@epa.gov]

**Attachments:** Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Agenda FINAL\_v2.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; AE Deliverables Table for BOSC 2021.pdf

**Start:** 10/14/2021 3:00:00 PM  
**End:** 10/14/2021 10:00:00 PM

**Recurrence:** (none)

**Required Attendees:** Hunt, Sherri; Sandy Smith; ca.geffen@pnnl.gov; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com;

**Optional  
Attendees:**

[Ex. 6]; Hubbell, Bryan; Bertrand, Savannah; Byrd, Camden; Scheuer, Amy; Gilman, Paul ;  
ljohnson@d.umn.edu  
Doa, Maria; Brown, Ann; Clark, Christopher; Vette, Alan; Winner, Darrell; Dodder, Rebecca; Hassett-Sipple, Beth;  
Sams, Elizabeth; Appel, Keith Wyat; Ross, Mary; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas;  
artwerner01 [Ex. 6] Hains, Jennifer (MDH); Frey, Christopher; Rodan, Bruce; Lass, Taylor; A-E Team; Chung,  
Serena; Miller, Andy; Lazzarino, Elisa; Vu, Chau; Elleman, Robert; Hill, Annelise; Shatas, Angie; Bierwagen, Britta;  
Watkins, Tim; Gilliland, Alice; Hagler, Gayle; Holt, Kay; Phelps, Lara; Pierce, Tom; Yelverton, Tiffany; Benner, Tim;  
Tran, Lynn; Stearns, Bailey; Beedlow, Peter

## Appointment

---

**To:** Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; jennifer hains[Ex. 6]; Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Iivers@ncsu.edu; Rohr, Annette [ARohr@epri.com]; Constance Senior [connie@conniesenior.com]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; canden.byrd@icf.com [Canden.Byrd@icf.com]; Scheuer, Amy [amy.scheuer@icf.com]; Paul Gilman [PGilman@covanta.com]; ljohnson@d.umn.edu; Hunt, Sherri [Hunt.Sherri@epa.gov]; Sandy Smith [Ex. 6] ca.geffen@pnnl.gov; Tracy, Tom [Tracy.Tom@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Sandy Smith [Ex. 6] ca.geffen@pnnl.gov; Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6] jennifer hains [Ex. 6] Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Iivers@ncsu.edu; Rohr, Annette [arohr@epri.com]; Constance Senior [connie@conniesenior.com]; [Ex. 6]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com; Amy.scheuer@icf.com; Gilman,Paul [PGilman@covanta.com]; ljohnson@d.umn.edu

**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6] Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]; ACE Team [ACE\_Team@epa.gov]; Chung, Serena [chung.serena@epa.gov]; Miller, Andy [Miller.Andy@epa.gov]; Lazzarino, Elisa [lazzarino.elisa@epa.gov]; Vu, Chau [Vu.Chau@epa.gov]; Elleman, Robert [Elleman.Robert@epa.gov]; Hill, Annelise [Hill.Annelise@epa.gov]; Shatas, Angie [Shatas.Angie@epa.gov]; Hassett-Sipple, Beth [Hassett-Sipple.Beth@epa.gov]; Watkins, Tim [Watkins.Tim@epa.gov]; Gilliland, Alice [Gilliland.Alice@epa.gov]; Hagler, Gayle [Hagler.Gayle@epa.gov]; Holt, Kay [Holt.Kay@epa.gov]; Phelps, Lara [Phelps.Lara@epa.gov]; Pierce, Tom [Pierce.Tom@epa.gov]; Yelverton, Tiffany [Yelverton.Tiffany@epa.gov]; Benner, Tim [Benner.Tim@epa.gov]; Tran, Lynn [Tran.Lynn@epa.gov]; Stearns, Bailey [stearns.bailey@epa.gov]; Sams, Elizabeth [Sams.Elizabeth@epa.gov]; Brown, Ann [Brown.Ann@epa.gov]; Clark, Christopher [Clark.Christopher@epa.gov]; Bierwagen, Britta [Bierwagen.Britta@epa.gov]; Vette, Alan [Vette.Alan@epa.gov]; Winner, Darrell [Winner.Darrell@epa.gov]; Dodder, Rebecca [Dodder.Rebecca@epa.gov]; Beedlow, Peter [Beedlow.Peter@epa.gov]; Brown, Ann [Brown.Ann@epa.gov]; Clark, Christopher [Clark.Christopher@epa.gov]; Bierwagen, Britta [Bierwagen.Britta@epa.gov]; Vette, Alan [Vette.Alan@epa.gov]; Winner, Darrell [Winner.Darrell@epa.gov]; Dodder, Rebecca [Dodder.Rebecca@epa.gov]; Beedlow, Peter [Beedlow.Peter@epa.gov]; Appel, Keith Wyat [Appel.Wyat@epa.gov]; Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6] Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]; ACE Team [ACE\_Team@epa.gov]; Chung, Serena [chung.serena@epa.gov]; Miller, Andy [Miller.Andy@epa.gov]; Lazzarino, Elisa [lazzarino.elisa@epa.gov]; Vu, Chau [Vu.Chau@epa.gov]; Elleman, Robert [Elleman.Robert@epa.gov]; Hill, Annelise [Hill.Annelise@epa.gov]; Shatas, Angie [Shatas.Angie@epa.gov]; Hassett-Sipple, Beth [Hassett-Sipple.Beth@epa.gov]; Watkins, Tim [Watkins.Tim@epa.gov]; Gilliland, Alice [Gilliland.Alice@epa.gov]; Hagler, Gayle [Hagler.Gayle@epa.gov]; Holt, Kay [Holt.Kay@epa.gov]; Phelps, Lara [Phelps.Lara@epa.gov]; Pierce, Tom [Pierce.Tom@epa.gov]; Yelverton, Tiffany [Yelverton.Tiffany@epa.gov]; Benner, Tim [Benner.Tim@epa.gov]; Tran, Lynn [Tran.Lynn@epa.gov]; Stearns, Bailey [stearns.bailey@epa.gov]; Sams, Elizabeth [Sams.Elizabeth@epa.gov]

**Attachments:** Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Agenda FINAL\_v2.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; AE Deliverables Table for BOSC 2021.pdf

**Start:** 10/13/2021 3:00:00 PM  
**End:** 10/13/2021 10:00:00 PM

**Recurrence:** (none)

**Required Attendees:** Hunt, Sherri; Sandy Smith; ca.geffen@pnnl.gov; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com;

**Optional  
Attendees:**

'artwerner01{ **Ex. 6** } Hubbell, Bryan; Bertrand, Savannah; Byrd, Camden; Scheuer, Amy; Gilman,Paul ;  
ljohnson@d.umn.edu  
Brown, Ann; Clark, Christopher; Bierwagen, Britta; Vette, Alan; Winner, Darrell; Dodder, Rebecca; Beedlow, Peter;  
Appel, Keith Wyat: Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas;  
artwerner01{ **Ex. 6** } Hains, Jennifer (MDH); Frey, Christopher; Rodan, Bruce; Lass, Taylor; A-E Team; Chung,  
Serena; Miller, Andy; Lazzarino, Elisa; Vu, Chau; Elleman, Robert; Hill, Annelise; Shatas, Angie; Hassett-Sipple, Beth;  
Watkins, Tim; Gilliland, Alice; Hagler, Gayle; Holt, Kay; Phelps, Lara; Pierce, Tom; Yelverton, Tiffany; Benner, Tim;  
Tran, Lynn; Stearns, Bailey; Sams, Elizabeth

## Appointment

---

**From:** Cowden, John [Cowden.John@epa.gov]  
**Sent:** 6/4/2021 1:39:57 PM  
**To:** Hotchkiss, Andrew [Hotchkiss.Andrew@epa.gov]; Lee, Janice [Lee.JaniceS@epa.gov]; Persad, Amanda [Persad.Amanda@epa.gov]; Keshava, Channa [Keshava.Channa@epa.gov]; Johnstone, Andrew [Johnstone.Andrew@epa.gov]; Arzuaga, Xabier [Arzuaga.Xabier@epa.gov]; Jones, Ryan [Jones.Ryan@epa.gov]; Jones, Samantha [Jones.Samantha@epa.gov]; Rooney, Andrew (NIH/NIEHS) [E] [andrew.rooney@nih.gov]; ram.ramabhadran [Ex. 6]; Gift, Jeff [Gift.Jeff@epa.gov]; Wilson, Richard [Wilson.Dick@epa.gov]; jackfowle@Ex. 6; Jamison, Eleanor [Jamison.Eleanor@epa.gov]; patty [patty@pattysellsnc.com]; rgantone@Ex. 6; Bahadori, Tina [Bahadori.Tina@epa.gov]; Hubal, Elaine [Hubal.Elaine@epa.gov]; meagankmadden@Ex. 6; Philpott, Olivia [Philpott.Olivia@epa.gov]; Thomas, David [Thomas.David@epa.gov]; Thomas, Russell [Thomas.Russell@epa.gov]; D'Amico, Louis [DAmico.Louis@epa.gov]; Gaul, Chuck [Gaul.Chuck@epa.gov]; Breeze, Joan [Breeze.Joan@epa.gov]; Whitlow, Jeff [Whitlow.Jeff@epa.gov]; Wade, Tim [Wade.Tim@epa.gov]; Baghdikian, Christina [Baghdikian.Christina@epa.gov]; Hoffman, Brian [Hoffman.Brian@epa.gov]; Vette, Alan [Vette.Alan@epa.gov]; Stroup, Gene [Stroup.Gene@epa.gov]; Voorhees, Scott [Voorhees.Scott@epa.gov]; Bass, Katherine [Bass.Katherine@epa.gov]; Blair, Susanna [Blair.Susanna@epa.gov]; Loughran, Michael [Loughran.Michael@epa.gov]; Williams, Antony [Williams.Antony@epa.gov]; Patlewicz, Grace [Patlewicz.Grace@epa.gov]; Shah, Imran [Shah.Imran@epa.gov]; Judson, Richard [Judson.Richard@epa.gov]; Rappazzo, Kristen [Rappazzo.Kristen@epa.gov]; Raimondo, Sandy [Raimondo.Sandy@epa.gov]; ljoca802 [Ex. 6]; Lavoie, Emma [Lavoie.Emma@epa.gov]; Scarano, Louis [Scarano.Louis@epa.gov]; Updike, David [Updike.David@epa.gov]; Frithsen, Jeff [Frithsen.Jeff@epa.gov]; George, Elizabeth [george.elizabeth@epa.gov]; ben.zukowski [ben.zukowski@yale.edu]; Holt, Daniel [Holt.Daniel@epa.gov]; Cybulski, Walter [Cybulski.Walter@epa.gov]; Burden, Susan [Burden.Susan@epa.gov]; thehamms19 [Ex. 6]; Herries, Katherine [Herries.Katherine@epa.gov]  
**CC:** ORD-RTP Feds and NonFeds [ORD-RTP\_Feds\_and\_NonFeds@epa.gov]; Rea, Anne [Rea.Anne@epa.gov]; Evans, Marina [Evans.Marina@epa.gov]; Ulrich, Elin [Ulrich.Elin@epa.gov]; Moravec, Miguel [moravec.miguel@epa.gov]; Lougee, Ryan [lougee.ryan@epa.gov]; Phillips, Allison [Phillips.Allison@epa.gov]; McMichael, Benjamin [McMichael.Benjamin@epa.gov]; Sacks, Anna [Sacks.Anna@epa.gov]; Williams, DavidJ [Williams.DavidJ@epa.gov]; Nyffeler, Johanna [nyffeler.johanna@epa.gov]; Hunt, Michelle [Hunt.Michelle@epa.gov]; Carlson, Laura [Carlson.Laura@epa.gov]; Delafield, Francis R [Francis.Delafield@jacobs.com]; James, Temberly [James.Temberly@epa.gov]; Paulsen, Heidi [Paulsen.Heidi@epa.gov]; Olin, Jeanene [Olin.Jeanene@epa.gov]; Offenber, John [Offenber.John@epa.gov]; Yelverton, William [Yelverton.William@epa.gov]; Oudejans, Lukas [Oudejans.Lukas@epa.gov]; Hoopes, Maria [Hoopes.Maria@epa.gov]; Hughes, MichaelF [Hughes.MichaelF@epa.gov]; Lewandowski, Michael [Lewandowski.Michael@epa.gov]; Adkins, Norman [adkins.norman@epa.gov]; Hines, Erin [Hines.Erin@epa.gov]; Isaacs, Kristin [isaacs.kristin@epa.gov]; Terry, Joyce [Terry.Joyce@epa.gov]; Gwinn, Maureen [gwinn.maureen@epa.gov]; Neas, Lucas [Neas.Lucas@epa.gov]; Milbeck, Regina [Milbeck.Regina@epa.gov]; Howe, Andrew [howe.andrew@epa.gov]; Kapraun, Dustin [Kapraun.Dustin@epa.gov]; Ahmed, Aranya [ahmed.aranya@epa.gov]; Folk, Gary [Folk.Gary@epa.gov]; Hassett-Sipple, Beth [Hassett-Sipple.Beth@epa.gov]; Jenkins, Molly [jenkins.molly@epa.gov]; Nilsen, Frances [nilsen.frances@epa.gov]; Mitchell, Bill [mitchell.bill@epa.gov]; Herbin-Davis, Karen [Herbin-Davis.Karen@epa.gov]; Childress, Velez [Childress.Velez@epa.gov]; Virtaranta, Larry [virtaranta.larry@epa.gov]; Chorley, Brian [Chorley.Brian@epa.gov]; Lau, Chris [Lau.Christopher@epa.gov]; Woodall, George [Woodall.George@epa.gov]; Best, Deborah [Best.Deborah@epa.gov]; Henson, Taylor [henson.taylor@epa.gov]; Johnson, Cortina [johnson.cortina@epa.gov]; Rosati, Jacky [Rosati.Jacky@epa.gov]; Daly, Ryan [Daly.Ryan@epa.gov]; Carstens, Kelly [Carstens.Kelly@epa.gov]; Schlosser, Paul [Schlosser.Paul@epa.gov]; Gillikin, Pamela [Gillikin.Pamela@epa.gov]; Rodgers, Hannah [Rodgers.Hannah@epa.gov]; Bartolotti, Andrea [bartolotti.andrea@epa.gov]; Thacker, Samuel [Thacker.Samuel@epa.gov]; Mitchell, Claudette [Mitchell.Claudette@epa.gov]; Burnham, Chad [burnham.chad@epa.gov]; Hemming, Brooke [Hemming.Brooke@epa.gov]; Ridley, Caroline [Ridley.Caroline@epa.gov]; Greene, Mary [greene.mary@epa.gov]; Duvall, Rachelle [Duvall.Rachelle@epa.gov]; Baker, Nancy C. [Baker.Nancy@epa.gov]; Spero, Tanya [Spero.Tanya@epa.gov]; Wright, Bob [Wright.Bob@epa.gov]; Herrick, Jeffrey [Herrick.Jeffrey@epa.gov]; Tucker, Nyssa [tucker.nyssa@epa.gov]; Jarabek, Annie [Jarabek.Annie@epa.gov]; Suarez, Danielle [Suarez.Danielle@epa.gov]; Wolf, Cynthia [Wolf.Cynthiaj@epa.gov]; Shores, Richard [Shores.Richard@epa.gov]; Jeffay, Susan [Jeffay.Susan@epa.gov]; Stanek, Lindsay [Stanek.Lindsay@epa.gov]; Dodder, Rebecca [Dodder.Rebecca@epa.gov]; Miller, Colette [Miller.Colette@epa.gov]; Lowe, Charles [lowe.charles@epa.gov]; Padilla, Stephanie [Padilla.Stephanie@epa.gov]; Daniel, Jessica [Daniel.Jessica@epa.gov]; Jackson, Stephen [Jackson.Stephen@epa.gov]; Dowd, Sean [Dowd.Sean@epa.gov]; Sayre,

Risa [sayre.risa@epa.gov]; Hartley, Jenna [hartley.jenna@epa.gov]; Kanta, Chander [Kanta.Chander@epa.gov]; Asongwe, Kisito [Asongwe.Kisito@epa.gov]; Styles, Jennifer [Styles.Jennifer@epa.gov]; Houck, Keith [Houck.Keith@epa.gov]; Gillespie, Andrew [Gillespie.Andrew@epa.gov]; Nelson, Garret [Nelson.Garret@epa.gov]; Lemieux, Paul [Lemieux.Paul@epa.gov]; Burns, Scott [Burns.Scott@epa.gov]; Browning, Morgan [browning.morgan@epa.gov]; Dietrich, Yijia [Dietrich.Yijia@epa.gov]; Chang, Daniel [chang.daniel@epa.gov]; Krajewski, Alison [krajewski.alison@epa.gov]; Stewart, Wendy M. [stewart.wendy@epa.gov]; Deisenroth, Chad [deisenroth.chad@epa.gov]; Sherman, Ramona [Sherman.Ramona@epa.gov]; Horton, Mary [horton.mary@epa.gov]; Loschin, Nicholas [Loschin.Nicholas@epa.gov]; Tolve, Nicolle [Tolve.Nicolle@epa.gov]; Kashef-Hamadani, Lilli [kashef-hamadani.lilli@epa.gov]; Freeman-Green, Veronica [Freeman-Green.Veronica@epa.gov]; Yost, Erin [Yost.Erin@epa.gov]; Hartig, Philip [Hartig.Phillip@epa.gov]; Martin, Melissa [Martin.Melissa@epa.gov]; Watkins, Tim [Watkins.Tim@epa.gov]; Morgan, Ardra [Morgan.Ardra@epa.gov]; Brooks, Lance [Brooks.Lance@epa.gov]; Dutton, Steven [Dutton.Steven@epa.gov]; Daniels, Rebecca [Daniels.Rebecca@epa.gov]; Dionisio, Kathie [Dionisio.Kathie@epa.gov]; Ryan, Shawn [Ryan.Shawn@epa.gov]; Everett, Logan [everett.logan@epa.gov]; Buschow, Ritchie D. [Buschow.Ritchie@epa.gov]; Hunter, Thelma [Hunter.Thelma@epa.gov]; Adams, DanielD [Adams.DanielD@epa.gov]; Ward-Caviness, Cavin [ward-caviness.cavin@epa.gov]; Harrill, Joshua [harrill.joshua@epa.gov]; Brixey, Laurie A [laurie.brixey@jacobs.com]; Sharma, Bhaskar [Sharma.Bhaskar@epa.gov]; Calfee, Worth [Calfee.Worth@epa.gov]; Owen, Russell [Owen.Russell@epa.gov]; Butts, Mary [Butts.Mary@epa.gov]; Roberts, Holly [Roberts.Holly@epa.gov]; Fairley, Terri [fairley.terri@epa.gov]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; McGhee, Patricia [McGhee.Patricia@epa.gov]; McCullough, Melissa [McCullough.Melissa@epa.gov]; Shafer, Timothy [Shafer.Tim@epa.gov]; Lyons, David [Lyons.David@epa.gov]; Massengill, William [massengill.william@epa.gov]; Montilla, Alex [Montilla.Alex@epa.gov]; Pilant, Drew [Pilant.Drew@epa.gov]; Karimi, Muhammad (Taha) [Karimi.Muhammad@epa.gov]; Tennant, Alan [Tennant.Alan@epa.gov]; Vega, Ann [Vega.Ann@epa.gov]; Geroux, Nicholas [Geroux.Nicholas@epa.gov]; Evans, Bryan [Evans.Bryan@epa.gov]; Clapper, Haley [Clapper.Haley@epa.gov]; Garner, Madeline [Garner.Madeline@epa.gov]; Frey, Christopher [Frey.Christopher@epa.gov]; Robbins, Chris [Robbins.Chris@epa.gov]

**Subject:** 14th Annual Hawaiian Shirt Friday Virtual Kickoff Luau  
**Location:** Virtual meeting (MS Teams link in invitation)

**Start:** 6/4/2021 5:00:00 PM  
**End:** 6/4/2021 6:00:00 PM  
**Show Time As:** Tentative

**Required Attendees:** Hotchkiss, Andrew; Lee, Janice; Persad, Amanda; Keshava, Channa; Johnstone, Andrew; Arzuaga, Xabier; Jones, Ryan; Jones, Samantha; Rooney, Andrew (NIH/NIEHS) [E]; ram.ramabhadra [Ex. 6] Gift, Jeff; Wilson, Richard; [Ex. 6] Jamison, Eleanor; 'Patty Gillespie'; 'Ray Antonelli'; Bahadori, Tina; Hubal, Elaine; meagankmadden [Ex. 6] Philpott, Olivia; Thomas, David; Thomas, Russell; D'Amico, Louis; Gaul, Chuck; Breeze, Joan; Whitlow, Jeff; Wade, Tim; Baghdikian, Christina; Hoffman, Brian; Vette, Alan; Stroup, Gene; Voorhees, Scott; Bass, Katherine; Blair, Susanna; Loughran, Michael; Williams, Antony; Patlewicz, Grace; Shah, Imran; Judson, Richard; Rappazzo, Kristen; Raimondo, Sandy; 'Lauren Joca'; Lavoie, Emma; Scarano, Louis; Updike, David; Frithsen, Jeff; George, Elizabeth; Zukowski, Ben; Holt, Daniel; Cybulski, Walter; Burden, Susan; Gisele Hamm; Herries, Katherine

**Optional Attendees:** ORD-RTP Feds and NonFeds; Rea, Anne; Evans, Marina; Ulrich, Elin; Moravec, Miguel; Lougee, Ryan; Phillips, Allison; McMichael, Benjamin; Sacks, Anna; Williams, DavidJ; Nyffeler, Johanna; Hunt, Michelle; Carlson, Laura; Delafield, Francis R; James, Temberly; Paulsen, Heidi; Olin, Jeanene; Offenber, John; Yelverton, William; Oudejans, Lukas; Hoopes, Maria; Hughes, MichaelF; Lewandowski, Michael; Adkins, Norman; Hines, Erin; Isaacs, Kristin; Terry, Joyce; Gwinn, Maureen; Neas, Lucas; Milbeck, Regina; Howe, Andrew; Kapraun, Dustin; Ahmed, Aranya; Folk, Gary; Hassett-Sipple, Beth; Jenkins, Molly; Nilsen, Frances; Mitchell, Bill; Herbin-Davis, Karen; Childress, Velez; Virtaranta, Larry; Chorley, Brian; Lau, Chris; Woodall, George; Best, Deborah; Henson, Taylor; Johnson, Cortina; Rosati, Jacky; Daly, Ryan; Carstens, Kelly; Schlosser, Paul; Gillikin, Pamela; Rodgers, Hannah; Bartolotti, Andrea; Thacker, Samuel; Mitchell, Claudette; Burnham, Chad; Hemming, Brooke; Ridley, Caroline; Greene, Mary; Duvall, Rachelle; Baker, Nancy C.; Spero, Tanya; Wright, Bob; Herrick, Jeffrey; Tucker, Nyssa; Jarabek, Annie; Suarez, Danielle; Wolf, Cynthia; Shores, Richard; Jeffay, Susan; Stanek, Lindsay; Dodder, Rebecca; Miller, Colette; Lowe, Charles; Padilla, Stephanie; Daniel, Jessica; Jackson, Stephen; Dowd, Sean; Sayre, Risa; Hartley, Jenna; Kanta, Chander; Asongwe, Kisito; Styles, Jennifer; Houck, Keith; Gillespie, Andrew; Nelson, Garret; Lemieux, Paul; Burns, Scott; Browning, Morgan; Dietrich, Yijia; Chang, Daniel; Krajewski, Alison; Stewart, Wendy M.; Deisenroth, Chad; Sherman, Ramona; Horton, Mary;

Loschin, Nicholas; Tolve, Nicolle; Kashef-Hamadani, Lilli; Freeman-Green, Veronica; Yost, Erin; Hartig, Philip; Martin, Melissa; Watkins, Tim; Morgan, Ardra; Brooks, Lance; Dutton, Steven; Daniels, Rebecca; Dionisio, Kathie; Ryan, Shawn; Everett, Logan; Buschow, Ritchie D.; Hunter, Thelma; Adams, DanielD; Ward-Caviness, Cavin; Harrill, Joshua; Brixey, Laurie A; Sharma, Bhaskar; Calfee, Worth; Owen, Russell; Butts, Mary; Roberts, Holly; Fairley, Terri; Hubbell, Bryan; McGhee, Patricia; McCullough, Melissa; Shafer, Timothy; Lyons, David; Massengill, William; Montilla, Alex; Pilant, Drew; Karimi, Muhammad (Taha); Tennant, Alan; Vega, Ann; Geroux, Nicholas; Evans, Bryan; Clapper, Haley; Garner, Madeline; Frey, Christopher; Robbins, Chris

**Because the luau is virtual, I removed the room number from the invitation to avoid potential confusion. Looking forward to virtually seeing folks today.** 😊

A virtual luau to get together while wearing Hawaiian Shirts. I'm happy to touch base after the luau as well. I hope that you're staying safe and well.

Aloha!

---

## Microsoft Teams meeting

**Join on your computer or mobile app**

[Click here to join the meeting](#)

**Or call in (audio only)**

Ex. 6

United States, Washington DC

Phone Conference ID: Ex. 6

[Find a local number](#) | [Reset PIN](#)

By participating in EPA hosted virtual meetings and events, you are consenting to abide by the agency's terms of use. In addition, you acknowledge that content you post may be collected and used in support of FOIA and eDiscovery activities.

[Learn More](#) | [Meeting options](#)

---

## Appointment

---

**From:** Tracy, Tom [Tracy.Tom@epa.gov]  
**Sent:** 10/12/2021 2:01:53 PM  
**To:** ca.geffen@pnnl.gov; Sandy Smith [Ex. 6]; Viney P Aneja [vpaneja@ncsu.edu]; Jeffrey.R.Arnold@usace.army.mil; Bart Croes [Ex. 6]; jennifer hains [Ex. 6]; Keslar, Cara [cara.keslar@wyo.gov]; mtkleinm@uci.edu; Myron Mitchell [mitchell@syr.edu]; Irviers@ncsu.edu; Rohr, Annette [arohr@epri.com]; Constance Senior [connie@conniesenior.com]; 'artwerner01 [Ex. 6]; Hubbell, Bryan [Hubbell.Bryan@epa.gov]; Hunt, Sherri [Hunt.Sherri@epa.gov]; Bertrand, Savannah [Bertrand.Savannah@epa.gov]; canden.byrd@icf.com; Amy.scheuer@icf.com; Gilman,Paul [PGilman@covanta.com]; ljohnson@d.umn.edu  
**CC:** Ross, Mary [Ross.Mary@epa.gov]; Doa, Maria [Doa.Maria@epa.gov]; Penalva-Arana, Carolina [Penalva-Arana.Carolina@epa.gov]; Trentacoste, Emily [trentacoste.emily@epa.gov]; O'Farrell, Thomas [O'Farrell.Thomas@epa.gov]; Art Werner [Ex. 6]; Hains, Jennifer (MDH) [Jennifer.Hains@state.mn.us]; Frey, Christopher [Frey.Christopher@epa.gov]; Rodan, Bruce [rodan.bruce@epa.gov]; Lass, Taylor [Lass.Taylor@epa.gov]; ACE Team [ACE\_Team@epa.gov]; Chung, Serena [chung.serena@epa.gov]; Miller, Andy [Miller.Andy@epa.gov]; Lazzarino, Elisa [lazzarino.elisa@epa.gov]; Vu, Chau [Vu.Chau@epa.gov]; Elleman, Robert [Elleman.Robert@epa.gov]; Hill, Annelise [Hill.Annelise@epa.gov]; Shatas, Angie [Shatas.Angie@epa.gov]; Hassett-Sipple, Beth [Hassett-Sipple.Beth@epa.gov]; Clark, Christopher [Clark.Christopher@epa.gov]; Bierwagen, Britta [Bierwagen.Britta@epa.gov]; Watkins, Tim [Watkins.Tim@epa.gov]; Gilliland, Alice [Gilliland.Alice@epa.gov]; Hagler, Gayle [Hagler.Gayle@epa.gov]; Holt, Kay [Holt.Kay@epa.gov]; Vette, Alan [Vette.Alan@epa.gov]; Phelps, Lara [Phelps.Lara@epa.gov]; Dodder, Rebecca [Dodder.Rebecca@epa.gov]; Pierce, Tom [Pierce.Tom@epa.gov]; Yelverton, Tiffany [Yelverton.Tiffany@epa.gov]; Benner, Tim [Benner.Tim@epa.gov]; Tran, Lynn [Tran.Lynn@epa.gov]; Brown, Ann [Brown.Ann@epa.gov]; Stearns, Bailey [stearns.bailey@epa.gov]; Winner, Darrell [Winner.Darrell@epa.gov]; Beedlow, Peter [Beedlow.Peter@epa.gov]; Sams, Elizabeth [Sams.Elizabeth@epa.gov]  
**Subject:** BOSC AE Subcommittee Mtg  
**Attachments:** Climate Change Tools.pdf; ACE BOSC\_CQ1\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ2\_Relevant Outputs-Products.pdf; ACE BOSC\_CQ3\_Relevant Outputs-Products.pdf; ACE BOSC\_STAR and Other ORD Research\_October2021.pdf; AE BOSC 20211012 Charge Questions FINAL.pdf; ACE Deliverables Table for BOSC 2021.pdf; AE BOSC 20211012 Agenda.pdf  
**Location:** ZOOM - Connection Info Below  
**Start:** 10/12/2021 3:00:00 PM  
**End:** 10/12/2021 10:00:00 PM  
**Show Time As:** Tentative  
**Recurrence:** Daily  
every day from 11:00 AM to 6:00 PM  
**Required Attendees:** ca.geffen@pnnl.gov; Sandy Smith; 'Viney Aneja'; Jeffrey.R.Arnold@usace.army.mil; Bart Croes; Jennifer Hains; Cara Keslar; mtkleinm@uci.edu; Myron J Mitchell; Louie Rivers; Rohr, Annette; connie@conniesenior.com; 'artwerner01 [Ex. 6]; Hubbell, Bryan; Hunt, Sherri; Bertrand, Savannah; Byrd, Canden; Scheuer, Amy; Gilman,Paul ; ljohnson@d.umn.edu  
**Optional Attendees:** Ross, Mary; Doa, Maria; Penalva-Arana, Carolina; Trentacoste, Emily; O'Farrell, Thomas; artwerner01 [Ex. 6]; Hains, Jennifer (MDH); Frey, Christopher; Rodan, Bruce; Lass, Taylor; A-E Team; Chung, Serena; Miller, Andy; Lazzarino, Elisa; Vu, Chau; Elleman, Robert; Hill, Annelise; Shatas, Angie; Hassett-Sipple, Beth; Clark, Christopher; Bierwagen, Britta; Watkins, Tim; Gilliland, Alice; Hagler, Gayle; Holt, Kay; Vette, Alan; Phelps, Lara; Dodder, Rebecca; Pierce, Tom; Yelverton, Tiffany; Benner, Tim; Tran, Lynn; Brown, Ann; Stearns, Bailey; Winner, Darrell; Beedlow, Peter; Sams, Elizabeth

Ex. 6

Meeting ID: [Ex. 6]

Passcode: [Ex. 6]

## Appointment

---

**From:** Matthews, Lisa [Matthews.Lisa@epa.gov]  
**Sent:** 2/22/2021 3:43:45 PM  
**To:** EPA ECOS ASTHO Bimonthly PFAS Call [EPA\_ECOS\_ASTHO\_Bimonthly\_PFAS\_Call@epa.gov]; Amy.E.Rousseau@des.nh.gov; ammcullen@pa.gov; kay.coffey@deq.ok.gov; patrick.gorski@wisconsin.gov; matthew.silver@wisconsin.gov; Buss, Stephanie D (DEC) [stephanie.buss@alaska.gov]; marc.nascarella@state.ma.us; Ryan, Jeff [Ryan.Jeff@epa.gov]; Nair, Anil [annair@pa.gov]; taylorj1@michigan.gov; Sareen, Neha [sareen.neha@epa.gov]; Ankley, Gerald [Ankley.Gerald@epa.gov]; Merrill, Raymond [Merrill.Raymond@epa.gov]; gsymmes@nas.edu; Jason.Johnson@ag.ny.gov; roger.brewer@doh.hawaii.gov; panzino.paula@azdeq.gov; Burneson, Eric [Burneson.Eric@epa.gov]  
**CC:** Orme-Zavaleta, Jennifer [Orme-Zavaleta.Jennifer@epa.gov]; Robbins, Chris [Robbins.Chris@epa.gov]; Frey, Christopher [Frey.Christopher@epa.gov]  
**Subject:** PFAS Science Call with EPA/ECOS/ASTHO  
**Attachments:** Agenda\_February 22 PFAS call.docx; PA DOH\_Biomonitoring and Assessment.pdf; OTM 45\_Ryan.pdf; Eco Needs for PFAS RA\_Ankley.pdf  
**Location:** Microsoft Teams Meeting  
**Start:** 2/22/2021 9:00:00 PM  
**End:** 2/22/2021 10:00:00 PM  
**Show Time As:** Tentative

**Required Attendees:** ECOS EPA Bimonthly PFAS Call; Amy.E.Rousseau@des.nh.gov; ammcullen@pa.gov; kay.coffey@deq.ok.gov; patrick.gorski@wisconsin.gov; matthew.silver@wisconsin.gov; stephanie.buss@alaska.gov; marc.nascarella@state.ma.us; Ryan, Jeff; Nair, Anil; taylorj1@michigan.gov; Sareen, Neha; Ankley, Gerald; Merrill, Raymond; gsymmes@nas.edu; Jason.Johnson@ag.ny.gov; roger.brewer@doh.hawaii.gov; panzino.paula@azdeq.gov; Burneson, Eric  
**Optional Attendees:** Orme-Zavaleta, Jennifer; Robbins, Chris; Frey, Christopher

Attached are the agenda and presentations for today's call.

EPA's Office of Research and Development (ORD) hosts a bimonthly call with ECOS, ASTHO and interested state representatives on PFAS. These calls are an opportunity for EPA scientists and our state partners to share science and technical information related to PFAS. Topics include analytical methods, human health and toxicity, site characterization, exposure and remediation, and treatment. If you would like to present on an upcoming call, please contact [Lisa Matthews](#). If you would like to be added to the email distribution list for these calls, please send requests to [Erin McCabe](#).

### Lisa Matthews

Senior Advisor and State Liaison  
US EPA Office of Research and Development  
202-564-6669

---

## Join Microsoft Teams Meeting

Ex. 6

United States, Washington DC (Toll)

Conference ID:

Ex. 6

Local numbers | [Reset PIN](#) | [Learn more about Teams](#) | [Meeting options](#)

ED\_006247N\_00002987-00001

By participating in EPA hosted virtual meetings and events, you are consenting to abide by the agency's terms of use. In addition, you acknowledge that content you post may be collected and used in support of FOIA and eDiscovery activities.

---

EPA-ECOS-ASTHO PFAS Science Call  
February 22, 2021  
4:00-5:00 PM Eastern

[ HYPERLINK ]

Ex. 6

# Ex. 6

[ HYPERLINK "tel:+" ]

Ex. 6

[ " " \t "\_blank" ]

Conference ID

Ex. 6

## AGENDA

*All times are Eastern*

- 4:00 PM      **Welcome and Opening Remarks**  
*Chris Frey, Deputy Assistant Administrator for Science Policy, EPA Office of Research and Development (ORD)*  
*Bruce Rodan, Associate Director for Science, EPA ORD*  
  
*Moderator – Lisa Matthews, EPA ORD*
- 4:05 PM      **Community Level Biomonitoring and Environmental Assessment for PFAS in Pennsylvania**  
*Anil Nair and Susan Wood, Pennsylvania Department of Health*
- 4:20 PM      **Other Test Method 45 – EPA Method for Targeted and Non-Targeted PFAS Measurements**  
*Jeff Ryan, EPA ORD Center for Environmental Measurement and Modeling*
- 4:35 PM      **Assessing the Ecological Risks of PFAS: Current State-of-the Science and Identification of Needs**  
*Gary Ankley, EPA ORD Center for Computational Toxicology and Exposure*
- 4:50 PM      **Q&A/Agency Updates (as time allows)**
- 5:00 PM      **Adjourn**

## **Community Level Biomonitoring and Environmental Assessment for PFAS in Pennsylvania**

The presentation will focus on PA's experience in conducting community level biomonitoring and environmental exposure assessment for PFAS. Presentation will include topics such as PFAS exposure history in the community studied, levels of PFAS detected in serum, urine, drinking water and household dust samples and the relationship between serum PFAS levels and various demographic and exposure characteristics.

## **Other Test Method 45 – EPA Method for Targeted and Non-Targeted PFAS Measurements**

EPA's Office of Research and Development, along with internal and external partners, has made significant contributions to the development and evaluation of sampling and analytical methods for detection of PFAS. Most recently, this included Other Test Method 45 (OTM-45) for the "Measurement of Selected Per- and Polyfluorinated Alkyl Substances from Stationary Sources," which provides users with a non-regulatory method for sampling and analyzing PFAS in air emissions. Sampling and analytical methods are a critical need to measure PFAS emissions from a variety of stationary sources and technologies including chemical manufacturing and industrial use such as coatings, thermal treatment, and emissions controls. OTM-45 provides a best practices method for the targeted measurement of as many as 50 semivolatile, polar PFAS compounds. This method will help other federal agencies, states, tribes, and communities have a consistent way to measure PFAS released into the air. The method is now posted on [ [HYPERLINK "https://www.epa.gov/emc/emc-other-test-methods"](https://www.epa.gov/emc/emc-other-test-methods) ]. This presentation will provide an overview of the method, its intended use, and future direction.

## **Assessing the Ecological Risk of PFAS: Current State of the Science and Identification of Needs**

The Society of Environmental Toxicology and Chemistry (SETAC) recently sponsored a workshop that focused on the state-of-the-science supporting risk assessment of PFAS. This presentation will summarize discussions concerning what is known about the ecotoxicology and ecological risks of PFAS. This presentation will also identify data gaps and needs, including the development of more comprehensive monitoring programs to support exposure assessment, an emphasis on research to support the formulation of predictive models for bioaccumulation, and the development of *in silico*, *in vitro*, and *in vivo* methods to efficiently assess biological effects for potentially sensitive species/endpoints. Addressing needs associated with assessing the ecological risk of PFAS will require cross-disciplinary approaches that employ both conventional and new methods in an integrated, resource-effective manner.



# Community Level Biomonitoring and Environmental Assessment for Per and Polyfluoroalkyl Substances (PFAS) in Pennsylvania

Anil Nair, Ph.D., MPH.

Susan Wood, MS.

Division of Environmental Health Epidemiology

Bureau of Epidemiology

Pennsylvania Department of Health

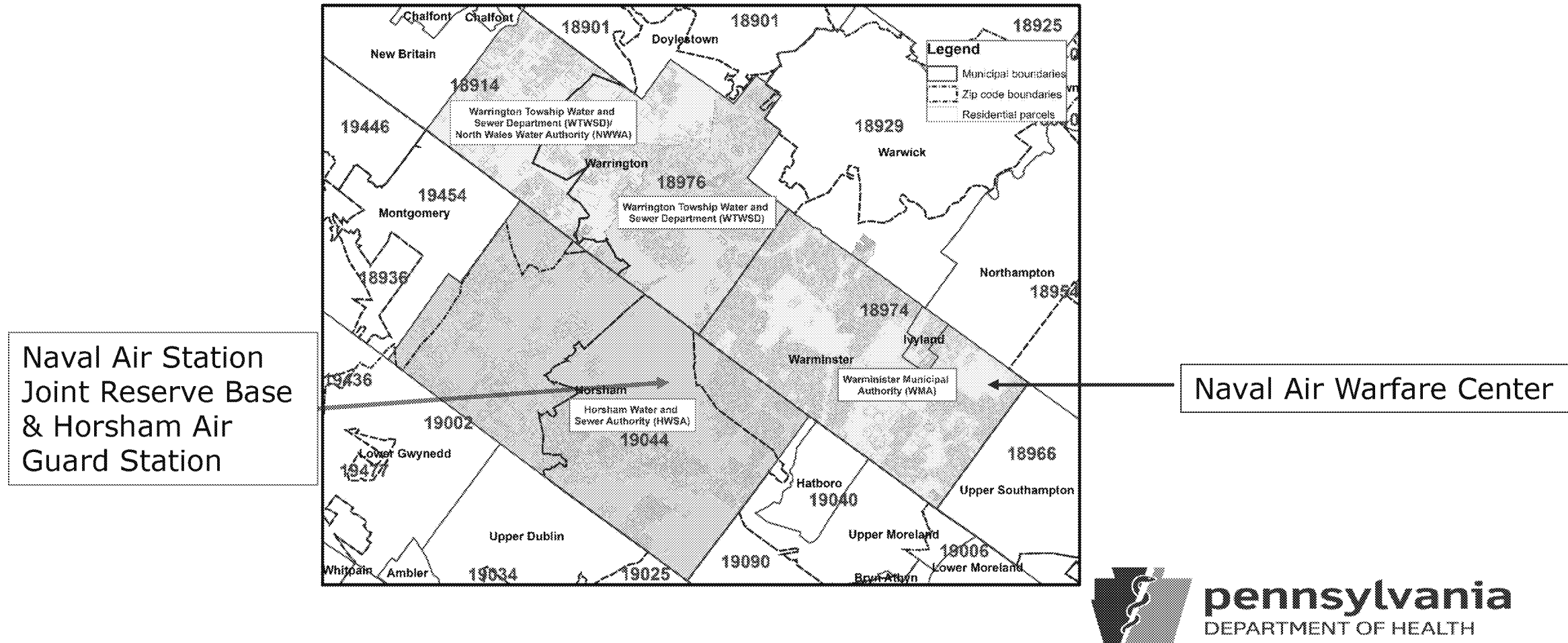
EPA-ECOS-ASTHO PFAS Science Call

February 22, 2021



# ➤ PFAS Exposure in Southeastern PA

- Affected area = population of 84,184 (2010 census)
- 32,595 households in water service area



# ▶ PEATT Pilot Project

- CDC asked Pennsylvania to perform a pilot study to check PFAS levels in community residents
- Weekly clinics in Bucks and Montgomery Counties to draw the blood samples from May through September 2018
- Testing on 235 participants
- July-November 2019 PA DOH tested PFAS levels in urine, household dust and tap water within those same households

# ➤ Participant Selection- Response Rates

- Total households contacted: 600
- Total households responded: 276
- Household level response rate: **46%**
- Number of eligible participants identified: 584 (including 113 kids aged 3-17 years)
- Number of eligible participants who completed the questionnaire and the informed consent form: 305
- Number of eligible participants who completed paperwork **AND** provided blood samples: 235 – from 118 households
- Individual participation rate: **40%** (235 out of 584)
- Household level participation rate: **19.6%** (118 out of 600 contacted)

# ➤ PEATT Project Demographics - Comparison

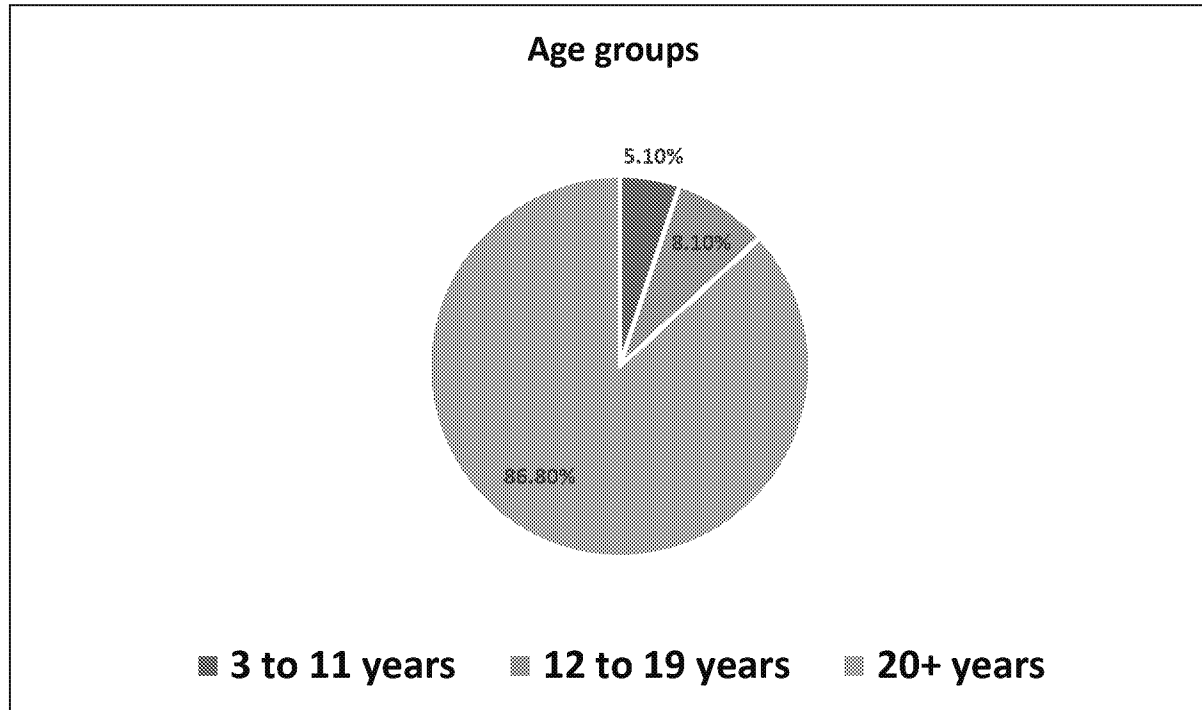
	Study Participants (%)	Community (%)	U.S. (%)
<b>Age</b>			
Under 12 years	5.1	14.9	15.8
12 to 19 years	8.1	10.9	11.2
20+ years	86.8	74.2	73.0
<b>Sex</b>			
Male	44.3	48.8	49.2
Female	55.7	51.2	50.8
<b>Race/Ethnicity</b>			
Hispanic or Latino	0	5.1	16.3
White	94.5	85.6	63.7
Black	0	3.0	12.2
Asian	0.4	4.8	4.7
Other	5.1	1.5	3.0
<b>Education Level (18+ years old)</b>			
Lower than College	20.6	34.7	40.5
Some College or more	74.2	65.3	59.5
Other	5.3	0.0	0.0

Study group determined by water service area, community determined by Warrington, Warminster, Horsham Twps, and Ivyland Borough

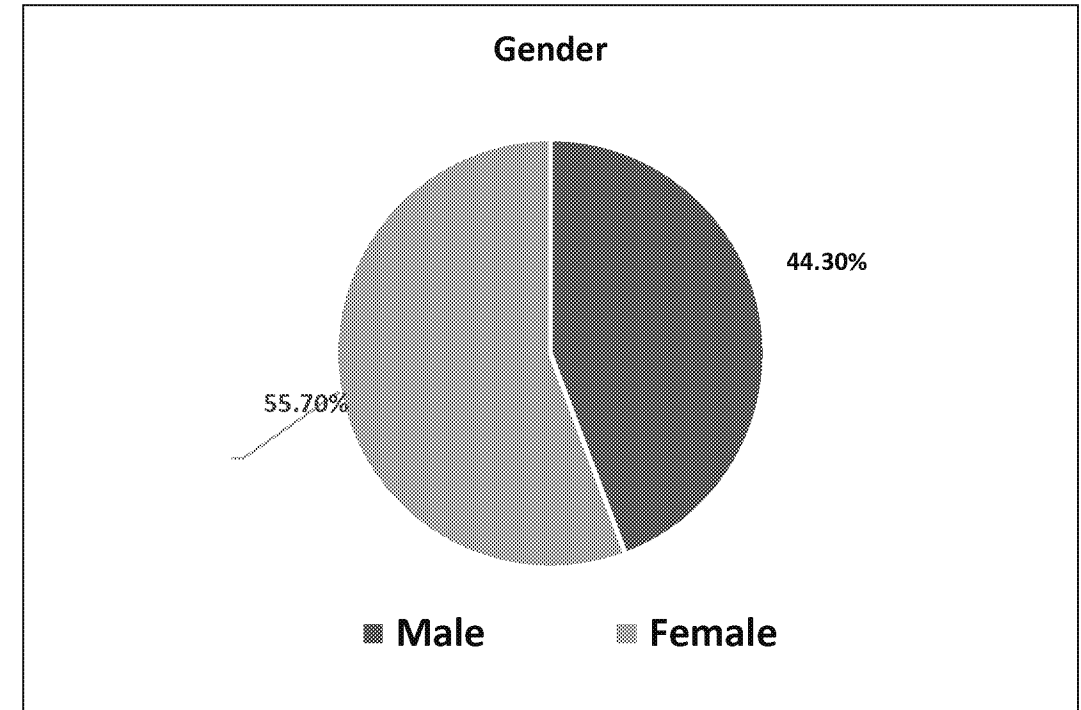


# Study Demographics

Mostly adults 20+ years old



More females than males

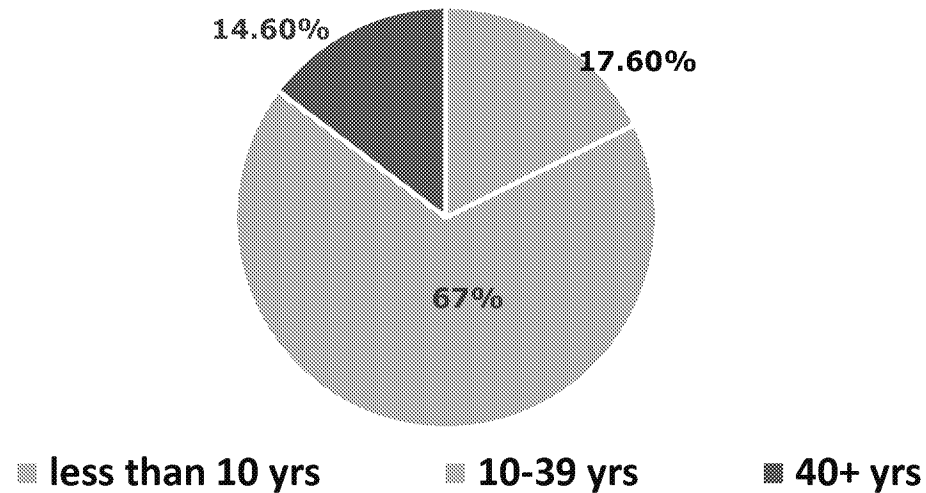


- Average age – 49 years
- 66% had college education or higher
- 12% were ever employed on a military base

# Study Demographics

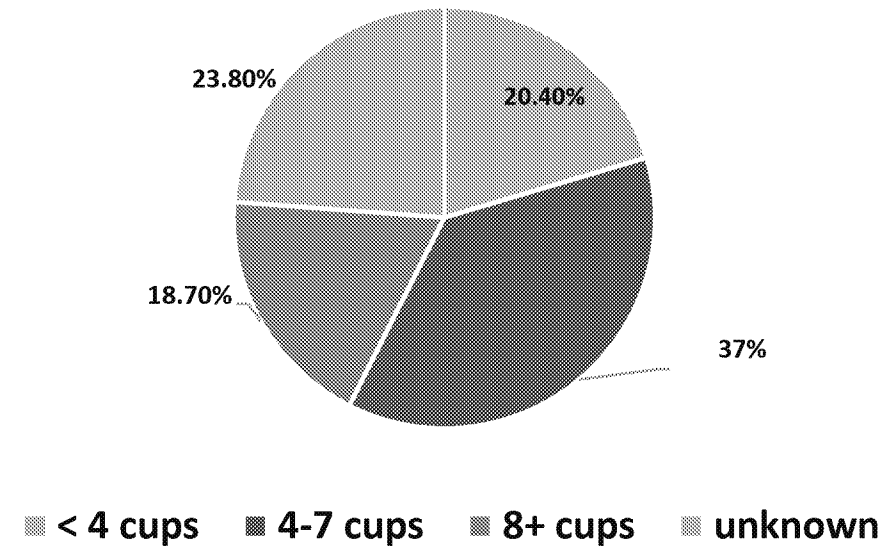
Most are long-term residents (>10 years)

Length of Residence



Estimated Tap Water Consumed Daily

Tap Water Daily



- 82% used public water

# Results in Blood

- Tested for 11 PFAS compounds
- 4 compounds were commonly detected
  - PFOS (100%)
  - PFHxS (99.0%)
  - PFOA (98.7%)
  - PFNA (78.1%)
  - All four detected in 79% of participants

Note: PFOS, PFOA and PFHxS are main components found in Aqueous Film Forming Foams (AFFF)

PFHxS has longer half-life in the body

PFOA used in non-stick surface coatings and water and stain resistant coatings

PFNA levels on the rise, biodegradation product during polyvinyl fluoride production/application

# ▶ Blood Results Overall

- Four most commonly found PFAS

	Community Results				NHANES Results (2013-2014)	
PFAS Compound	Average	95% Confidence Interval	Median	Range	Average	95% Confidence Interval
PFOA	<b>3.13</b>	2.81-3.50	3.06	0.55-24.8	<b>1.94</b>	1.76-2.14
PFOS	<b>10.24</b>	8.86-11.83	9.86	1.02-105.00	<b>4.99</b>	4.50-5.52
PFHxS	<b>6.64</b>	5.51-7.99	6.61	0.54-116.00	<b>1.35</b>	1.20-1.52
PFNA	<b>0.74</b>	0.67-0.80	0.76	0.50-2.56	<b>0.68</b>	0.61-0.74

Results shown in ug/L. Range excludes <LOD

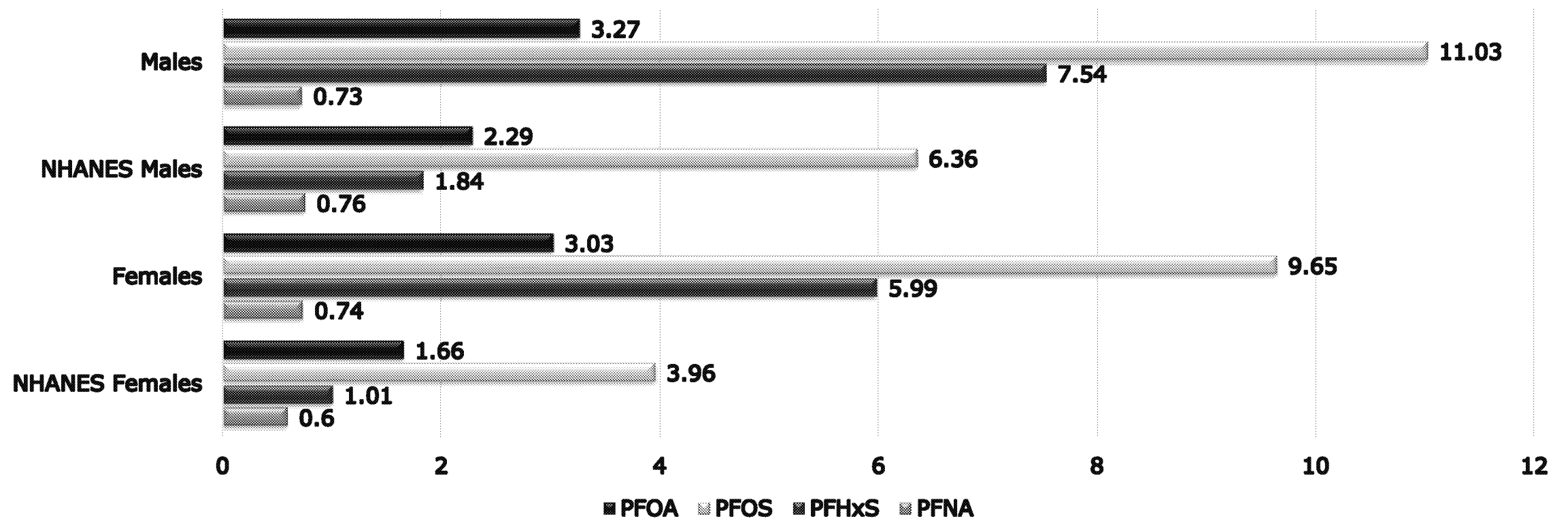
# ➤ Serum PFAS Levels (ug/L) by Age Groups

	Community Results						NHANES Results (2013-2014)					
PFAS Compound	Age (years)						Age (years)					
	3-11 (12)		12-19 (19)		20+ (204)		3-11 years		12-19 years		20+ years	
	Average	95% C.I.	Average	95% C.I.	Average	95% C.I.	Average	95% C.I.	Average	95% C.I.	Average	95% C.I.
PFOA	<b>2.02</b>	1.66-2.45	<b>2.17</b>	1.70-2.78	<b>3.32</b>	2.96-3.72	<b>1.92</b>	1.75-2.12	<b>1.66</b>	1.50-1.84	<b>1.98</b>	1.79-2.19
PFOS	<b>3.91</b>	3.02-5.07	<b>5.18</b>	3.93-6.83	<b>11.50</b>	10.08-13.12	<b>3.88</b>	3.53-4.27	<b>3.54</b>	3.17-3.96	<b>5.22</b>	4.70-5.81
PFHxS	<b>2.00</b>	1.24-3.23	<b>2.99</b>	2.19-4.09	<b>7.63</b>	6.41-9.08	<b>0.84</b>	0.76-0.94	<b>1.27</b>	1.06-1.53	<b>1.36</b>	1.21-1.53
PFNA	<b>0.39</b>	0.35-0.43	<b>0.57</b>	0.43-0.76	<b>0.78</b>	0.72-0.84	<b>0.79</b>	0.68-0.93	<b>0.60</b>	0.49-0.73	<b>0.69</b>	0.63-0.75

Significant ( $P \leq 0.05$ ) difference in levels of all four PFAS among age groups within the community

# ➤ Serum PFAS Levels (ug/L) by Gender

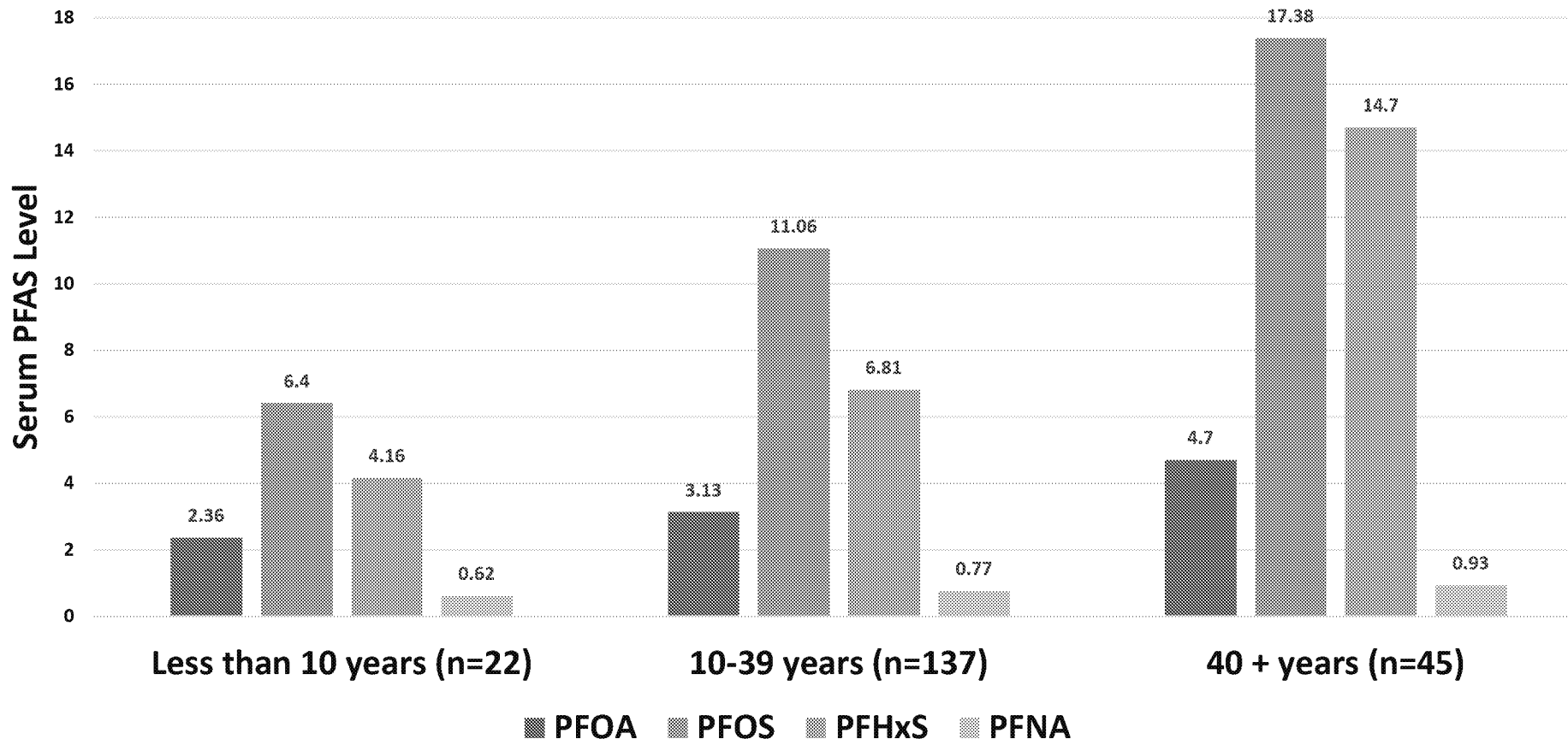
PFAS Levels by Gender (Community vs. NHANES 2013-2014)



Difference between male (n=104) and female (n=131) participants not statistically significant ( $P > 0.05$  for all four compounds)



# Serum PFAS Levels (ug/L) by Total Length of Residence



Statistically significant ( $p \leq 0.05$ ) difference in levels of all 4 PFAS between categories